The Inefficient Combination: Competitive Markets, Free Entry, and Democracy[1]

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Abstract

We show that under fairly general conditions, the combination of (i) competitive markets, (ii) free entry, and (iii) democracy is inconsistent with allocative efficiency. This fundamental impossibility result, which has not been derived before, holds whenever not only prices, but also policy, responds to factor allocations. We develop a theory where agents enter an occupation (more generally, enter an economic activity) and thereafter make a policy decision. Thus, each voter's self-interest becomes endogenous to the entry decision. In our baseline model, the policy instrument that citizens decide upon is simply taxation. Workers in occupations whose services are in high demand by the government have an incentive to vote for high taxes. Voters in occupations whose services are in low demand by the government have an incentive to vote for low taxes. We show that the socially efficient size of the public sector cannot be sustained in equilibrium, despite free entry into occupations. We generalize our theory, and show how our impossibility result extends well beyond the baseline model. We also discuss how departing from competitive markets may affect equilibrium outcomes. Our analysis implies that when assessing causes and consequences of factor allocations, it is key to acknowledge how allocations affect not only prices, but also policies.

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1 Introduction

A tenet of economics is that scarcity invites entry. Factors in scarce supply are generously remunerated, making it profitable to enter where scarcity is most acute. In turn, these incentives are efficient for society: with free entry and perfect competition, the marginal productivities in different activities are equalized, ensuring allocative efficiency. In this paper we argue that this basic economic insight needs to be reconsidered when a majority has more influence over policy than a minority, as in a democracy. Factor allocations then affect not only market prices, but also economic policy. By implication, being one of the few may come with a cost, as policies tend to be tilted toward majority interests. It follows that scarcity works like a double-edged sword for the individual. On the one hand, scarce activities yield high income. On the other hand, entering a scarce activity entails joining the politically weak. While the first incentive promotes efficiency, the second does not. As a consequence, under fairly general conditions the combination of (i) competitive markets, (ii) free entry, and (iii) democracy is inconsistent with allocative efficiency.

The intuition behind our impossibility result is illustrated by the following example. Consider a textbook economics environment where agents choose between two different occupations. All agents receive the same payoff within each occupation. Equilibrium with free entry involves an arbitrage condition where, on the margin, payoffs from either alternative are equal. Given this standard arbitrage condition, no agent regrets his or her occupational choice. Under the well-known conditions for perfect competition, this is also the socially optimal allocation of factors of production. Note that this situation naturally involves one minority group and one majority group. Now, introduce politics. Assume there exists a policy instrument which increases the utility of the majority relative to the minority. Assume also that the majority has more political power than the minority. Then in the socially optimal allocation the majority group will be better off than the minority: absent policy, both occupations are equally well off at the social optimum, but with policy the majority derives an additional (relative) benefit from policy choice. Thus, the standard arbitrage condition is not fulfilled. The social optimum cannot constitute an equilibrium.[1] This explains in a simple way our result that the combination

[1] As will be clear below, our impossibility result does not require that the majority has more political power than the minority. If the opposite is the case, for instance due to lobbying, the impossibility result still holds. All that is needed for the result to go through,

of (i) competitive markets, (ii) free entry, and (iii) democracy is inconsistent with allocative efficiency.[2]

To the best of our knowledge, neither our impossibility result, nor the mechanisms behind it, have previously been stated and analyzed. There are, however, a number of literatures that our paper relates to. In the example above, as well as in our general impossibility result, a crucial feature is that voters cannot commit to vote for a future policy which is against their own interest (when the future arrives). Thus our result relates to the more general literature on political economy, of which Acemoglu (2003, p. 622) asks

> "why do politicians and powerful social groups not make a deal with the rest of the society to choose the politics and institutions that maximize output or social welfare, and then redistribute parts of the gains to themselves?"

He goes on to argue, however, that the problem with such a solution is that (p. 622) "its applicability is limited because of inherent commitment problems associated with political power." Indeed, this view is critical for our impossibility result to be valid. If voters could commit to policy ahead of their entry into activities then entry would ensure that also the (endogenous) factor allocation became optimal and our impossibility result would not hold. Our model is thus related to the large literature focusing on the lack of commitment and time inconsistency starting with Kydland and Prescott (1977). However, compared to much of this literature, it is not politicians but *voters* that cannot commit to their future political behavior. For this reason our mechanism can also extend some of the results in the previous literature. To see why, consider the well-known example of capital taxation where a policymaker cannot commit to holding taxes low once capital is in place. Thus investment suffers, and the capital stock becomes smaller than what is socially optimal. But what if those entering as investors become so numerous that they are able to tilt policy

is that political influence varies with group size. See also footnote 21.

[2]As we discuss in Sections 2.4, 2.5 and 3, the impossibility result holds under more general assumptions than in this simple example. For instance, it is not necessary that agents choose their occupation once and for all, as in the example. With a small but strictly positive cost of changing occupation, the impossibility result is unaffected. Note also that the only claim we make in this paragraph is that the efficient allocation is *not* an equilibrium. To answer what *can* constitute an equilibrium, more model structure is required than what the simple example in this paragraph provides. We discuss possible political economy equilibria informally further down in the introduction, and formally in Sections 2 and 4.

in their preferred direction? Then the endogenous entry has created a situation where low capital taxes may constitute a political equilibrium. Moreover, too low capital taxes may attract more investors, cementing this equilibrium. Allowing entry that makes voter characteristics endogenous may, in this way, turn the previous prediction of too high capital taxes on its head.[3]

Our emphasis on economic entry naturally relates our paper to theories of political entry, in particular the citizen-candidate model of Osborne and Slivinsky (1996) and Besley and Coate (1997, 1998). As in their setting, endogenous entry may result in multiple equilibria where no-arbitrage conditions are satisfied, as entry decisions are strategic and depend on what others do. In our setting it is the endogenous entry of voters into economic activity, and not of the politicians, that drives our results, and for this reason the welfare implications differ from those of the citizen-candidate models. In particular, in citizen-candidate models the equilibrum may be socially efficient, while in our approach it cannot.

As regards entry of voters, our paper is related to those of voter mobility originating from the work of Tiebout (1956). A main difference is that in this literature entry into some jurisdictions is driven by exogenous differences in voter interests, while in our model voters' political interests are endogenous to entry.[4] Models of social mobility, in particular such as those of Benabou and Ok (2001), Hassler et al. (2003), Benabou and Tirole (2006), and Acemoglu, Egorov and Sonin (2018), also study voters' entry into different groups. As a result, also in these models policy preferences shift when agents transition from one social group to another. However, in these models entry does not ensure equal payoffs, and they emphasize different issues than we consider. Our idea is possibly more closely related to Acemoglu, Johnson and Robinson (2005), who study why England and the Netherlands diverged economically and politically from Spain and Portugal with the discovery of the New World. They emphasize different entry conditions, where in the two former countries entrepreneurs were allowed to take part in the new trade to a much larger extent than in the two latter, where these possibilities were monopolized and regulated by the crown and its allies. In turn, entry of new entrepreneurs in England and the

[3]To see a possible relevance of this, consider, for example, the classical study by Rosen and Rosen (1980) of how favorable tax treatment of owner-occupied housing stimulates homeownership. Our approach would imply that the extent of homeownership is not only a consequence of the tax system, but also a cause.

[4]For this reason the welfare implications are also very different. See chapter 8 in Drazen (2000) for a detailed discussion of welfare implications in the literature on fiscal federalism.

Netherlands made this group politically more powerful, in turn being able to tilt institutions in favor of more secure property rights. Although their focus and results are very different from our approach, our model does share with Acemoglu, Johnson and Robinson (2005) the property that entry affects factor allocations, and, more importantly, that factor allocations in turn affect the balance of political power.

A widely studied observation in political economy that can serve to illustrate the relevance of our approach, is the huge variation in public sector size across different countries. Comparing France and the UK, for example, the two countries have approximately the same level of GDP per capita, but (based on OECD data from 2017) general government spending is 56,5% of GDP in France while it is 40,8% in the UK (and 38,0% of GDP in the US, despite the US having approximately a 50% higher GDP per capita). There are, as we discuss below, several theoretical and empirical studies of why the size of the public sector differs so massively between countries. Our impossibility result suggests a new, and in our view plausible, explanation. Perhaps the expected payoff from working in the public sector in France is high exactly because the public sector is big, making public employees powerful enough to support policies that bolster their own remuneration. In the UK, by contrast, it could be less tempting to aim for a public sector career exactly because the public sector is small, making public employees politically weak. In other words, it could be more attractive to enter the public sector in those countries where there is an abundance of public sector employees, not scarcity.

In order to transparently develop our impossibility result, we start by addressing this familiar question of government size. First, we establish the optimal size of government within a simple framework similar to the influential model of Barro (1990). Then, we study the consequences of introducing the combination of competitive markets, free entry, and democracy. This allows us to derive our result that this combination is inconsistent with allocative efficiency within a well-known environment. The contributions most closely related to this particular application are probably two papers with discussion of public bureaucracies by Tullock (1974) and Buchanan and Tullock (1977). In the first of these papers, Tullock notes that as the number of bureaucrats increases (p. 129)

> "it would be possible to use more and more of their power to directly increase wages. In a sense, the individual bureaucrat tries

to increase his wages, but realizes that there are political gains from increasing the number of bureaucrats in that he will be able to have more political power to increase his wage in the next period. Expansion becomes a sort of investment."

In Buchanan and Tullock (1977) this view is developed further, linking it to the voting patterns of public sector employees under the heading "Wagner Squared". When the share of the public sector increases with economic growth, for instance because public goods and services have an income elasticity that exceeds unity (Wagners law), then, according to Buchanan and Tullock (1977, p. 148), as

> "[...] the bureaucracy members come to make up a larger and larger share of the total voting constituency, the possibility of the usage of civil servant voting power to expand salaries directly becomes real."

Hence, as in the underpinnings of our impossibility result, Buchanan and Tullock point out that the political interests of agents are shaped by their occupations,[5] that these interests can be more forcefully represented the larger the occupational group is, and that this may increase the funds allocated to this group further. There are, however, many differences between their analysis and ours. While these previous discussions treated entry as determined by demand, in our theory entry is determined by supply as well. Moreover, Buchanan and Tullock only analyze one group of voters (public sector employees) and thus do not observe that the mechanism they discuss might equally well imply the opposite of what they claim, namely that the public sector may become too small. In addition, Buchanan and Tullock do not develop a fully specified political economy model, propose our general impossibility result, nor register the paradox that it is the combination of free entry and perfectly competitive markets that causes allocative inefficiency in a democracy.[6]

[5]Lindbeck (1995) points out a similar mechanism in that (p. 14) "An unwinding of welfare-state spending could be expected to be particularly difficult in societies where a large share of the electorate is financed by the public sector (i.e. is tax financed rather than market-financed.)" Similarly, Christoffersen and Paldam (2003) develop the concept of "the welfare coalition" to describe such a situation. The conjecture that individual occupation causally affects policy preferences finds empirical support in e.g. Rattsø and Sørensen (2016).

[6]Determinants of the size of the public sector have been extensively studied in the political economy literature. In Meltzer and Richard (1981) the size of the public sector is determined by income inequality, where high income inequality produces a high tax rate. Persson,

The rest of our paper is organized as follows. In Section 2 we present our baseline model of occupational choice and occupational voting, in Section 2.3 we characterize the socially optimal allocation, and in Section 2.4 we derive the political equilibrium and provide our impossibility result. In Section 3 we generalize the impossibility result. In Section 4 we study the implications of departing from the free market institutional component and illustrate how our impossibility result sheds new light on a much debated problem of factor misallocation, namely the Dutch disease. In the Appendix we extend our analysis to an environment with a continuum of sectors, and show that the impossibility result remains valid also in such a setting.

2 A Model of the Size of Government

In this section we develop a model which in a simple way illustrates our impossibility result by considering a specific question, namely what determines the size of government. We also discuss the possible political economic equilibria.[7]

2.1 Preferences, Technology, and Institutions

We consider a society with a continuum of citizens of measure normalized to 1. Citizens decide to enter as workers in one out of two sectors, where they inelastically supply one unit of labor. These two sectors could be the private or the public sector, service or manufacturing, traded or non-traded, and so on. In the Appendix we consider a continuum of sectors. In this section, we simply term the two sectors the traded and the non-traded sector.

Citizens have preferences over private consumption and the provision of a

Roland and Tabellini (1997, 2000) show how separation of powers influences the size of the public sector, and how this can be interpreted as differences between characteristics of political institutions, such as if there is a presidential or parliamentary system, or if the election system is proportional or majoritarian (on this see also Lizzeri and Persico, 2001, and Milesi-Ferretti, Perotti and Rostagno, 2002). In these theories, in contrast to ours, voter characteristics are exogenous and there is no entry of voters, which is the driving mechanism in our model. For a more complete review of the political economy literature on government size, see several of the chapters in Persson and Tabellini (2000) or Besley (2006), or chapter 14 in Drazen (2000), which is entirely devoted to this issue.

[7]Note that our impossibility result, as a statement about what cannot be an equilibrium, holds under fairly general conditions, as we show in Section 3. What actually can constitute an equilibrium, however, is more dependent on the precise model considered.

public good. Citizen i derives utility according to

$$U_i = c_{N,i}^{\alpha} c_{T,i}^{\beta} g^{\gamma}, \quad \alpha + \beta + \gamma = 1, \tag{1}$$

where $c_{N,i} \geq 0$ denotes i's consumption of non-traded goods (N), $c_{T,i} \geq 0$ denotes the consumption of traded goods (T), and g is the flow of public goods provided by government. With a slight abuse of notation, we utilize that in equilibrium citizens' consumption will differ only as a result of the sector they supply labor to and let U_j represent the utility of a typical citizen in the workforce of sector $j \in \{N, T\}$. Similarly, $c_{N,T}$ will denote consumption of non-traded goods of a typical citizen working in the traded sector, and so on.

We let l_N and l_T denote the mass of citizens who constitute the non-traded and the traded sector workforces, respectively. All citizens supply labor to one of the two sectors, hence $l_N + l_T = 1$. We let n_j denote the labor actually employed in sector $j \in \{N, T\}$. Moreover, we assume that within each sector there is full insurance, meaning that even in the presence of unemployment within a sector j ($l_j > n_j$), all income is shared among the citizens in that sector's workforce.[8] Traded goods are the numeraire, and denoting the price of non-traded relative to traded goods, i.e. the real exchange rate, by p, and wages in terms of traded goods in the two sectors by w_N and w_T, respectively, we have the budget constraint for each citizen in the workforce of sector j as

$$pc_{N,j} + c_{T,j} = (1 - \tau)\, w_j \eta_j, \quad j \in \{N, T\}, \tag{2}$$

where $\eta_j \equiv \frac{n_j}{l_j}$, i.e. the employment rate in sector j (which equals unity when there is no unemployment).

One unit of non-traded sector labor produces one unit of non-traded goods, and one unit of traded sector labor produces one unit of traded goods. Public

[8] In the baseline model set out in this section, with a fully competitive labor market, there will not be unemployment and thus $n_j = l_j$. We still make the model slightly more general when we present it, since in the extension with explicit labor market institutions in Section 4.1, we will allow for unemployment. The assumption of full insurance is unimportant for our results, but simplifies our exposition in this extension by allowing us to characterize only two types of citizens, one for each sector, rather than to also distinguish between the unemployed and the employed. The reason insurance is unimportant, is that employment is determined after taxes, and hence also after voting. Thus when voting takes place, all agents within a sector face the same ex ante indirect utility function, even if some individuals might become unemployed at a later stage of the game.

goods g are purchased from the non-traded sector.[9] Thus, non-traded and traded goods available for private consumption, denoted by x_N and x_T respectively, are given by

$$x_N = n_N - g, \tag{3}$$

and

$$x_T = n_T. \tag{4}$$

We assume that trade is balanced.[10] Hence, the goods markets in each sector j clears when

$$x_j = l_N c_{j,N} + l_T c_{j,T}. \tag{5}$$

There is perfect (Bertrand) competition in goods markets. Given linear production technologies, profits are zero, and wages are simply determined to equal the value of the marginal productivity of labor. Since the marginal productivity of labor is unity in both types of production, wages in a sector are always equal to prices in the sector. Wages thus satisfy

$$w_N = p, \tag{6}$$

and

$$w_T = 1. \tag{7}$$

We return to the equilibrium determination of p below.

Turning next to the political decision, this simply regards the level of the tax rate and, by implication, the size of the public sector. Each citizen votes for a tax rate $\tau_j \in [0,1]$, where the subscript $j \in \{N, T\}$ indicates that the voting decision may depend on the worker's sector. Any tax rate that receives a majority of votes is implemented, and we denote the implemented tax rate by τ.

The public sector budget constraint reads

$$pg = \tau \left(n_N w_N + n_T \right), \tag{8}$$

[9] In the Appendix where we extend the model to a continuum of sectors, public goods may be purchased from all sectors.

[10] Because trade is balanced, supply will equal demand for both goods, and the model can be interpreted as a two-sector model also of a closed economy, for instance as a model of services and manufactured goods production. Thus we use the formulation non-traded and traded goods just as a simple way to term the two sectors, in addition to that this is the characterization used in models of the Dutch disease, which we study in one of our applications.

where we have already incorporated from (7) that we have $w_T = 1$. Note that the tax rate not only determines the provision of public goods, but, as will become clear, also affects the supply and demand of private goods.

2.2 Timing of Events and Equilibrium Concept

To summarize, the timing of events is as follows:

1. Each citizen undertakes his occupational choice, i.e. decides in which sector to enter.

2. Each citizen votes for a tax rate. The tax rate that receives a majority of votes is implemented.

3. Each citizen supplies one unit of labor to his sector.

4. Production, prices and wages are determined. Each citizen gets his income, and derives utility from private consumption and public goods.

A strategy for citizens simply determines their choice of sector, voting over the tax rate, and their consumption decisions. A subgame perfect equilibrium (SPE) is defined, as usual, as a strategy profile in which all actions are best responses to other strategies in all histories. Since we have many voters, the set of SPEs involves a large number of equilibria in which voters use weakly dominated strategies, such as voting for a tax rate that is not preferred because a majority of other voters are doing so. To rule out such unreasonable equilibria we focus on (pure-strategy) SPEs in undominated strategies. In our setting, where voters in each group will all have the same expected utility, and where there are only two groups of voters, this will simply imply that in equilibrium each citizen votes for his most preferred tax rate.[11]

We next investigate the socially optimal allocation in this economy, and thereafter turn to the analysis of the model.

2.3 Social optimum

With linear utility, any distribution of consumption between different citizens is consistent with a social optimum. Hence, the distribution between citizens

[11] We also adopt the convention that if two tax rates receive the same amount of votes, the tax rate is decided by the tax rate preferred by a majority of traded sector workers. This has no bearing on our results, and only works to simplify notation.

can be ignored here. Let g^o denote the first-best level of public goods, c_N^o the first-best level of non-traded goods, and so on. We then have:

Proposition 1 *The socially optimal allocation satisfies*

$$g^o = \gamma, c_N^o = \alpha, c_T^o = \beta, l_N^o = n_N^o = \alpha + \gamma, l_T^o = n_T^o = 1 - n_N^o = \beta.$$

Proof. Under inelastic supply of labor and positive marginal utility of consumption, a socially optimal labor allocation implies that all labor is used for production. It follows that $l_N^o = n_N^o$, $l_T^o = n_T^o$, and that $n_T^o = 1 - n_N^o$. Given this, and given the unit labor requirement in all production technologies, we can write the maximization problem of a social planner as

$$\max_{[g, l_N]} (l_N - g)^\alpha (1 - l_N)^\beta g^\gamma.$$

The two first-order conditions w.r.t. g and l_N, respectively, read

$$\frac{\alpha}{l_N - g} - \frac{\gamma}{g} = 0, \tag{9}$$

and

$$\frac{\alpha}{l_N - g} - \frac{\beta}{1 - l_N} = 0. \tag{10}$$

By solving (9) for l_N, and using the resulting expression to substitute for l_N in (10), we obtain $g(\alpha + \beta + \gamma) = \gamma$. Because $\alpha + \beta + \gamma = 1$, the first part of the proposition follows; $g^o = \gamma$. The labor allocation $l_N^o = \alpha + \gamma$ then follows by inserting $g^o = \gamma$ into (9), while (10) implies $1 - l_N^o = \beta$. Finally, given production, levels of consumption follow. ■

2.4 Competitive and Political Equilibrium

In this section we characterize the economy's equilibrium outcomes in two cases. First, we assume that after entry there is occupational immobility, as reflected in the timing of events specified in Section 2.2. Thereafter, we relax this timing assumption and study the case where workers can switch occupation.

Occupational Immobility

We solve for the model's SPEs by backward induction. We start with a citizen in a given sector, facing a given tax rate, given prices, and a given net income, and characterize consumption choice. Thereafter, we characterize the voting decision, given the occupational choice of a citizen. After this characterization, we go to the first stage of the game, where we determine occupational choice, i.e. entry into the non-traded and traded sector. Finally, we contrast the possible SPEs with the social optimum.

Preliminaries

For later use it is useful to characterize the final stage where goods markets clear in a way that holds no matter how wages are determined, i.e. also when there is unemployment. All citizens maximize (1) subject to (2), taking goods prices, wages, and the tax rate as given. The resulting consumption demands are

$$c_{N,j} = \frac{\alpha}{(\alpha+\beta)\,p}\,(1-\tau)\,w_j\eta_j, \quad j \in \{N,T\}, \tag{11}$$

and

$$c_{T,j} = \frac{\beta}{\alpha+\beta}\,(1-\tau)\,w_j\eta_j, \quad j \in \{N,T\}. \tag{12}$$

From (4), (12), (5) and $\eta_j \equiv \frac{n_j}{l_j}$, it follows that in the traded goods sector, supply equals demand when

$$n_T = \frac{\beta}{\alpha+\beta}\,(1-\tau)\,[n_N w_N + n_T w_T].$$

Utilizing $w_T = 1$ and $w_N/w_T = p$, we may conveniently express this market clearing condition as

$$p\frac{n_N}{n_T} = \frac{\alpha+\tau\beta}{\beta\,(1-\tau)}, \tag{13}$$

which will be central in what follows.

Next, after combining (11), (12) and (8) with (1), we observe that the utility citizens finally enjoy in any equilibrium is

$$U_j = \Phi\,(1-\tau)^{1-\gamma}\,\tau^{\gamma}\left(w_j\eta_j\right)^{1-\gamma}\left(n_N + \frac{n_T}{w_N}\right)^{\gamma} p^{-\alpha}, \tag{14}$$

where $\Phi \equiv \frac{\alpha^{\alpha}\beta^{\beta}}{(\alpha+\beta)^{\alpha+\beta}} > 0$. The term $(1-\tau)^{1-\gamma}\,\tau^{\gamma}$ reflects the same trade-off as in Barro (1990), regarding the size of the public sector. On the one hand, public goods directly increase utility. On the other hand, their financing is costly in terms of private goods foregone. Maximization of this term alone gives the Barro result that the optimal size of the public sector entails $\tau = \gamma$.

Expression (14) provides an important insight: the direct effect of taxes (τ) on a citizen's utility is independent of his or her sectoral attachment (j). Hence, the only sources of conflict regarding preferred government size, are the indirect effects of taxes through prices and quantities in the labor market (w_j, η_j, n_j).

Market clearing for given taxes and sectoral labor supplies

Under competitive markets the equilibrium involves wages determined by (6) and (7), and full employment $l_j = n_j$ in both sectors j.[12]

With full employment, clearing of the traded goods market as expressed by (13) implies a relationship between the equilibrium real exchange rate and the pre-determined tax rate and work-force composition:

$$p = \frac{l_T}{l_N} \frac{\alpha + \beta\tau}{\beta(1-\tau)}. \tag{15}$$

Intuitively, a higher tax rate shifts demand in the direction of non-traded labor and appreciates the real exchange rate for given l_N and l_T.

Voting over the Tax Rate

Having characterized equilibrium outcomes for a given workforce composition and tax rate, we now analyze the preceding stage of the game: the voting over taxes. For that purpose, it is useful to first find workers' indirect utility functions over taxes.

From (6), (7), $\eta_j = 1$, and (14), it follows that non-traded and traded sector workers obtain the utilities

$$U_N = \Phi (1-\tau)^{1-\gamma} \tau^{\gamma} \left(l_N + \frac{(1-l_N)}{p} \right)^{\gamma} p^{\beta}, \tag{16}$$

and

$$U_T = \Phi (1-\tau)^{1-\gamma} \tau^{\gamma} \left(l_N + \frac{(1-l_N)}{p} \right)^{\gamma} p^{-\alpha}. \tag{17}$$

Comparing the two expressions, we note that the indirect utility functions are nearly identical. The only difference arises in the last terms containing p on the right hand sides of (16) and (17). These terms reveal that there is a

[12] This is because if there is unemployment then, with exogenous labor supply, labor can be hired at wage zero. This is not consistent with labor demand falling short of labor supply, since by hiring labor one could get goods for free. Thus, there cannot exist unemployment in equilibrium.

conflict of interest between workers in the two sectors: a real exchange rate appreciation always benefits workers in the non-traded sector more than workers in the traded sector. The reason is that a higher real exchange rate shifts the income distribution toward non-traded sector workers. Note that this conflict of interest carries over to taxation, as the real exchange rate characterized by (15) is monotonically increasing in τ. Consequently, the optimal tax rate from the point of view of non-traded sector workers, τ_N, is always higher than the optimal tax rate from the point of view of traded sector workers, τ_T. Moreover, the preferred tax rates will lie on each side of the first-best tax rate, γ. This allows us to establish the following lemma:

Lemma 1 *The optimal tax rates for N-workers (τ_N) and T-workers (τ_T), exist, are unique, and satisfy $\tau_N > \gamma > \tau_T$.*

Proof. *After inserting (15) into (16) and (17), the indirect utility functions over taxes may be compactly expressed as*

$$U_N \equiv U_N(l_T, l_N, \tau) = \Lambda_N (1-\tau)^{\alpha} \tau^{\gamma} (\alpha + \beta\tau)^{\beta-\gamma}, \tag{18}$$

where $\Lambda_N = \Phi \frac{(l_T)^{\beta}}{(l_N)^{\beta-\gamma}} \frac{(\alpha+\beta)^{\gamma}}{\beta^{\beta}}$, *and*

$$U_T \equiv U_T(l_T, l_N, \tau) = \Lambda_T (1-\tau)^{2\alpha+\beta} \tau^{\gamma} (\alpha + \beta\tau)^{-\alpha-\gamma}, \tag{19}$$

where $\Lambda_T = \Phi \frac{(l_N)^{\alpha+\gamma}}{(l_T)^{\alpha}} (\alpha+\beta)^{\gamma} \beta^{\alpha}$. *Differentiating (18) and (19) with respect to τ, yields:*

$$\frac{dU_N}{d\tau} = \Lambda_N U_N \left[\frac{\gamma}{\tau} + \frac{\beta(\beta-\gamma)}{(\alpha+\beta\tau)} - \frac{\alpha}{(1-\tau)} \right], \tag{20}$$

and

$$\frac{dU_T}{d\tau} = \Lambda_T U_T \left[\frac{\gamma}{\tau} - \frac{\beta(\alpha+\gamma)}{(\alpha+\beta\tau)} - \frac{(2\alpha+\beta)}{(1-\tau)} \right]. \tag{21}$$

It immediately follows that $\lim_{\tau\to 0} dU_j/d\tau > 0$ *and* $\lim_{\tau\to 1} dU_j/d\tau < 0$, *for* $j = N, T$. *Hence, the optimal tax rates τ_N and τ_T both lie in the interval $\langle 0, 1\rangle$. Because both U_N and U_T are differentiable over $\tau \in \langle 0, 1\rangle$, it follows from (20) and (21), as well as utilizing that $\gamma = 1 - \alpha - \beta$, that τ_N and τ_T satisfy the first-order conditions:*

$$\tau_N = \left\{ \tau \in \langle 0, 1\rangle : -\beta\tau^2 - \left(\frac{\alpha}{\alpha+\beta} - \beta \right) \tau + \frac{(1-\alpha-\beta)\alpha}{\alpha+\beta} = 0 \right\}, \tag{22}$$

and

$$\tau_T = \left\{ \tau \in \langle 0,1 \rangle : -\beta\tau^2 - \left(\frac{\alpha}{\alpha+\beta} + \alpha \right)\tau + \frac{(1-\alpha-\beta)\alpha}{\alpha+\beta} = 0 \right\}. \tag{23}$$

Note that (22) and (23), being quadratic, have at most two solutions. Moreover, since $\lim_{\tau\to 0} dU_j/d\tau > 0$ *and* $\lim_{\tau\to 1} dU_j/d\tau < 0$*, it follows that at the interval* $\langle 0,1 \rangle$ *(22) and (23) both have a strictly positive odd number of solutions. It then follows that both (22) and (23) have one, and only one, solution at the interval* $\langle 0,1 \rangle$*. Thus the optimal tax rates* τ_T *and* τ_N *are unique. Together, (20) and (21) imply that* $\frac{dU_N}{d\tau} > 0$ *evaluated in* $\tau = \tau_T$

$$\frac{dU_N}{d\tau} = \Lambda_N U_N \left[\frac{\beta(\beta+\alpha\gamma)}{(\alpha+\beta\tau_T)} + \frac{\alpha+\beta}{(1-\tau_T)} \right] > 0.$$

As $\frac{dU_N}{d\tau} > 0$ *evaluated in* τ_T*, the optimal* τ_N *must be larger than* τ_T*,* $\tau_N > \tau_T$*.*

Moreover, if $\tau = \gamma$*,* $\frac{dU_N}{d\tau} > 0$ *while* $\frac{dU_T}{d\tau} < 0$*. As* $\frac{dU_N}{d\tau} > 0$ *evaluated in* γ*, the optimal* τ_N *must be larger than* γ*. As* $\frac{dU_N}{d\tau} < 0$ *evaluated in* γ*, the optimal* τ_T *must be smaller than* γ*. Hence,* $\tau_T < \gamma < \tau_N$*, which completes the proof.* ■

The intuition for this result is that a higher tax rate brings a greater provision of public goods. This shifts demand (at given wages and prices) for non-traded goods up. To re-establish an equilibrium with less non-traded goods available for private consumption, the price of non-traded goods, and the wage for non-traded labor, has to increase. In the new equilibrium, an elevated tax rate is therefore associated with a real exchange rate appreciation. A real exchange rate appreciation is, viewed in isolation, advantageous for non-traded sector workers because their (pre-tax) consumer real wage increases, while it hurts the traded sector workers since their (pre-tax) consumer real wage decreases. For this reason, the non-traded sector workers always prefer a higher tax rate, and a larger public sector, than the traded sector workers.

Note also that from (22) and (23) the preferred tax rates τ_N and τ_T are independent of how citizens are allocated across sectors, given by l_N and l_T (yet to be determined). This property has less generality than the result stated in Lemma 1, as it rests on the utility functions assumed, but it still provides useful intuition. Behind it lie two countervailing forces that cancel out exactly in the Cobb-Douglas case. On the one hand, a higher share of non-traded sector workers pulls toward a higher preferred tax rate, as relatively more resources are available to produce public goods. On the other hand, a higher share of non-traded workers allows for more private consumption of non-traded goods, which pulls the preferred tax rate down.

We can now determine which tax rate that ultimately is implemented. Due to our restriction to weakly undominated strategies, in equilibrium voters simply vote for the tax rate they prefer. Thus, the political equilibrium tax rate, τ, is decided by the majority. Hence,

$$\tau = \begin{cases} \tau_N \text{ if } & l_N > 1/2 \\ \tau_T \text{ if } & l_N \leq 1/2. \end{cases} \tag{24}$$

Occupational Choice

We now turn to the first stage of the game where l_N and l_T are determined by citizens' occupational choice. Any equilibrium must imply that no citizen regrets his or her occupational choice, given the policy that will eventually be decided. Hence, absent corner solutions the occupational decision must imply $U_N = U_T$, where utilities follow from equations (16) and (17).[13] As seen from these equations, the indifference condition boils down to $p = 1$. From (6) and (7) this condition in turn means that $w_N = w_T$. Inserting $p = 1$ in (15), and solving with respect to l_N, we obtain

$$l_N = \frac{\alpha + \beta\tau}{\alpha + \beta}. \tag{25}$$

Thus, the fraction of citizens entering the non-traded sector increases with the equilibrium tax rate. A high tax rate implies high demand for non-traded relative to traded sector labor, which (all else equal) makes it relatively attractive to enter the non-traded sector.

Equilibrium

Taking into account that the choice of taxes and occupations must satisfy equations (24) and (25) in equilibrium, we can now characterize the possible SPEs.

First, from equation (25) we directly observe that $l_N > 1/2$ if τ is sufficiently high. Moreover, the tax choice (24) implies that if $l_N > 1/2$, then $\tau = \tau_N$. Hence, there will exist a threshold tax level $\overline{\tau}$ such that if all citizens prefer taxes above this rate, then $l_N > 1/2$ and N-workers who consti-

[13] In our model, corner solutions can never be part of an SPE because our assumed utility function has the property $\lim\limits_{c_j \to 0} \frac{dU_i}{dc_j} = \infty$.

tute the majority decide the tax rate. From (25), this threshold tax level is $\overline{\tau} = (\beta - \alpha)/2\beta$. Moreover, because we have established that $\tau_N > \tau_T$, a sufficient condition for $l_N > 1/2$, is that $\tau_T > \overline{\tau}$. Hence, if $\tau_T > \overline{\tau}$, the equilibrium is unique with $\tau = \tau_N$ and $l_N > 1/2$.

Second, equation (25) also implies that $l_N < 1/2$ if τ is sufficiently low. By a similar logic as above, we conclude that there exists a threshold tax level, $\underline{\tau}$, such that if all citizens prefer taxes below this rate, $l_N < 1/2$ and T-workers constitute the majority and thus decide the tax rate. From (25), this threshold tax level is $\underline{\tau} = (\beta - \alpha)/2\beta$. Because $\tau_N > \tau_T$, a sufficient condition for $l_N < 1/2$, is that $\tau_N < \underline{\tau}$. Hence, if $\tau_N < \underline{\tau}$, the equilibrium is unique with $\tau = \tau_T$ and $l_N < 1/2$.

Third, we note that if $\tau_T < (\beta - \alpha)/2\beta < \tau_N$, there are two possible equilibria. Assume that when choosing their occupation, citizens expect $\tau = \tau_N$. Then, according to (25), an equilibrium must entail $l_N > 1/2$. Naturally, when taxes later are voted over and set according to (24), the initial expectation is confirmed. Hence, $l_N > 1/2$ and $\tau = \tau_N$ is one possible equilibrium. Now assume citizens expect $\tau = \tau_T$. Then, according to (25), an equilibrium must entail $l_N < 1/2$. When taxes later are voted over and set according to (24), the initial expectation is confirmed. Hence, $l_N < 1/2$ and $\tau = \tau_T$ is another possible equilibrium.

Moreover, note that in any SPE citizens have the same utility across sectors (since citizens in one sector all have the same utility, and since in any SPE the occupational decision implies that the no-arbitrage condition $U_N = U_T$ is fulfilled). Therefore, when comparing two situations, the one that is more socially efficient Pareto dominates the other situation.

The following proposition summarizes these insights (proof in text):

Proposition 2 *The possible SPEs are as follows:*

1. *If $\frac{\beta-\alpha}{2\beta} < \tau_T$, then $\tau = \tau_N$ with $l_N > 1/2$ is the unique SPE.*
2. *If $\tau_N < \frac{\beta-\alpha}{2\beta}$, then $\tau = \tau_T$ with $l_N \leq 1/2$ is the unique SPE.*
3. *If $\tau_T < \frac{\beta-\alpha}{2\beta} < \tau_N$, there are two SPEs:*
   (a) *$\tau = \tau_N$ with $l_N > 1/2$,*
   (b) *$\tau = \tau_T$ with $l_N \leq 1/2$,*

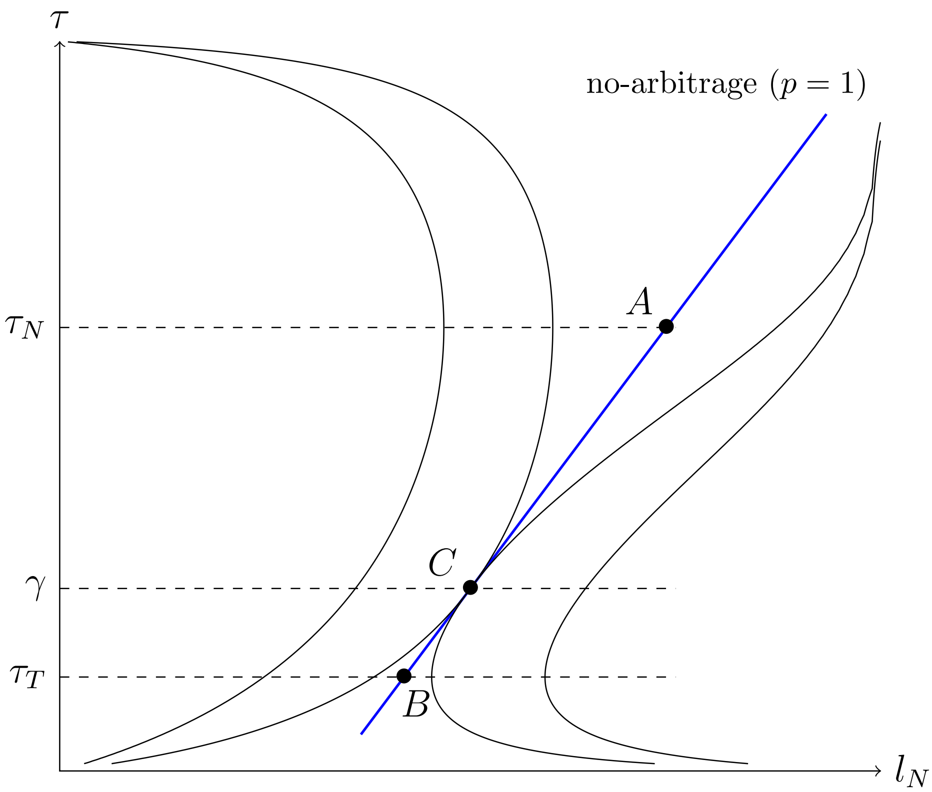
with τ_N determined as the solution to (22) and τ_T as the solution to (23). The size of the public sector will never be socially optimal. If $\tau = \tau_N$, the public sector is larger than is socially optimal. If $\tau = \tau_T$, the public sector is smaller than is socially optimal. The socially efficient situation $\tau = \gamma$ Pareto dominates all SPEs.

Proposition 2 contains the impossibility result: under free entry, perfectly competitive markets, and democracy, social optimum cannot be achieved. The reason is simple: entry affects not only equilibrium factor prices, entry also affects political power. The majority group will tilt policy in its own favor. But since agents realize this at the point of entry, a no-arbitrage equilibrium must, necessarily, involve too much entry into the political majority and too little entry into the political minority. Scarcity on the one hand invites entry since it is economically attractive to supply the scarce factor, but on the other hand deters entry because it is politically unattractive to be among the owners of the scarce factor. From the point of view of society, however, entry due to scarcity is the relevant incentive, while entry motivated by being among the politically powerful is not. The impossibility result holds under more general, and weaker, conditions than in this particular model, and we generalize the impossibility result in Section 3.

Figure 1 further clarifies the intuition underlying Proposition 2. Here we have depicted case 3 in the proposition, where there exist two possible SPEs. One possible equilibrium is point A where $\tau = \tau_T$ and $l_N \leq 1/2$, while the other possible equilibrium is point B where $\tau = \tau_N$ and $l_N > 1/2$.

The figure displays both worker types' indifference curves in the (l_N, τ) plane, as dictated by equations (18) and (19). The two curves to the right in the figure represent two indifference curves for traded workers. The preference direction is rightward. Intuitively, for a given tax rate the utility of a traded sector worker increases in l_N, as that makes his labor scarcer; fewer traded workers implies a shortage of traded goods, which increases the wage in the traded relative to the non-traded sector (depreciates the real exchange rate p), and hence increases the purchasing power of traded sector workers. The D-shaped indifference curves to the left represent two indifference curves for a non-traded sector worker. The preference direction for them is leftward; lowering the number of non-traded workers for a given tax rate creates a shortage of non-traded goods that increases the wage in the non-traded relative to the traded sector (appreciates the real exchange rate p), and hence increases a

Figure 1: Preferred tax rate for N and T-workers and candidates for equilibrium



Notes: The two curves to the right depict indifference curves for traded-sector workers. The two curves to the left depict indifference curves for non-traded-sector workers. The blue upward-sloping line in the middle represents combinations of the workforce composition (l_N) and the tax rate (τ) such that the real exchange rate (p), is unity.

non-traded worker's purchasing power.

For both traded and non-traded sector workers, utility is first increasing, then decreasing, in the tax rate. One mechanism is identical for the two groups. Raising the tax from zero first supports the provision of essential public goods, hence utility increases. As τ (and hence g) increases, the marginal gain from additional public goods declines. Eventually, the gain is less than the opportunity cost and utility declines. For non-traded sector workers, however, as we have seen, higher taxation comes with an additional positive effect. Keeping l_N fixed, a higher tax rate creates a shortage of non-traded workers, which increases the price of non-traded goods and increases the real wage of non-traded workers. For traded-sector workers this same effect leads to a reduction in their real wage. Consequently, as we established in Lemma 1, for a given l_N, the traded-sector workers have a preferred tax rate below the preferred tax rate for non-traded workers. Moreover, as we also established in Lemma 1, the socially optimal size of the public sector, γ, exceeds that financed by the tax rate τ_T, and falls short of that financed by τ_N. The reason is that when l_N is predetermined, taxation redistributes purchasing power from workers in the traded sector to workers in the non-traded sector. Starting out with a tax rate equal to γ, therefore, traded sector workers would like to see the tax rate reduced while non-traded sector workers would like to see it increased.

As explained above, free entry implies that the no-arbitrage condition $p = 1$ holds so that no worker regrets her choice of sector. The straight line in the figure gives the combinations of l_N and τ that are consistent with $p = 1$ from equation (25). Hence, we see that the two points A and B are possible SPEs because they each maximize the utility of the majority and satisfy $p = 1$. The efficient point C however, is not an SPE. No majority would ever vote for $\tau = \gamma$. In the current example, B is the better of the two possible equilibria. Hence, if the economy ends up in A rather than in B, this is to be considered a coordination failure.

Whether there are one or two SPEs depends on the location of the $p = 1$ line, and in particular for what two values of l_N it intersects τ_N and τ_T. If non-traded goods generally are in high demand, i.e. if α is high, $l_N > 1/2$ even when $\tau = \tau_T$ and the only equilibrium will then be A, where the median voter has entered into the non-traded sector. This is case 1 of Proposition 2. Conversely, if traded goods are in high demand, i.e. β is sufficiently high, then B will be the only equilibrium. This is case 2 of Proposition 2.

A promise to vote for $\tau = \gamma$ would not be credible for anyone, and thus cannot support the socially efficient equilibrium C, even if C Pareto dominates both A and B.

Occupational Mobility

An important question is if our impossibility result is subject to the Wittman-critique that "behind every model of government failure is an assumption of extreme voter stupidity, serious lack of competition, or excessively high negotiation/transfer costs," (Wittman, 1989, p. 1422). Clearly, there is no voter stupidity nor lack of competition behind our result. However, a remaining question is if the result rests on high costs of transferring from one occupation to another. Indeed, in the model as we have presented it so far, the occupational choice is once and for all, with no possibility to switch occupation at later stages of the game. We now relax this assumption and allow citizens to switch occupation at a strictly positive, possibly infinitely small, transfer cost ϵ.

Occupational mobility allows citizens to switch occupation after observing policy. We will first establish that no additional SPEs than those in Proposition 2 can exist. Thereafter we turn to the question of when the SPEs in Proposition 2 remain.

To establish that no additional SPEs exist, we start out at the last stage of the game. Without loss of generality, assume the N sector is in majority. A citizen will not switch occupation if the utility gain from doing so falls short of the transfer cost ϵ. Therefore, for any factor allocation l_N there is an interval of tax rates such that there is no occupational switching. Within this interval there is one and only one tax rate, given by equation (25), that fulfills the arbitrage condition exactly. Term this tax rate τ_U. Thus, at any factor allocation l_N the median voters choice must be τ_U in order for this factor allocation to be part of an SPE. Consider any factor allocation l_N that differs from the allocations in Proposition 2. Then τ_U also differs from the tax rates in Proposition 2. But majority citizens can always do at least marginally better than voting for τ_U (again, given that $\tau_U \neq \tau_N$). To see this, note that when $\tau_U \neq \tau_N$, majority citizens can vote for a tax rate that gives them marginally higher utility without making minority agents shift into the majority group (i.e. by keeping the utility differential between sectors less than ϵ). Such a tax rate gives the majority citizens higher utility than voting for τ_U. Thus, SPEs other than those in Proposition 2 do not exist.[14]

It follows that the only candidates for SPEs are those in Proposition 2. We now turn to the question of when they actually remain equilibria under occupational mobility.

The first order conditions for SPEs in Proposition 2 were derived under the restriction of no occupational mobility. Recall that we focus on SPEs in undominated strategies. The question is whether there exists a deviation in tax choice, which by causing occupational mobility makes the majority better off, and thereby also rules out the SPEs from Proposition 2.[15]

Assume that N is the majority and denote the factor allocation and tax rate in the SPE from Proposition 2 by (l_N^*, τ_N). Majority agents then prefer a tax rate and a subsequent sector movement of workers if there exists a τ such that

$$U_N(1 - l_N, l_N, \tau) = U_T(1 - l_N, l_N, \tau) - \epsilon, \tag{26}$$

$$U_N(1 - l_N, l_N, \tau) > U_N(1 - l_N^*, l_N^*, \tau_N). \tag{27}$$

The first condition states that some workers should be willing to move from sector N to sector T. The second condition states that the majority should be better off. By combining the two conditions it follows that

$$U_T(1 - l_N, l_N, \tau) > U_N(1 - l_N, l_N, \tau) > U_N(1 - l_N^*, l_N^*, \tau_N).$$

Hence, a new candidate for (l_N, τ) must Pareto dominate the candidate(s) in Proposition 2 (and in order to generate moving, the T sector workers in this new candidate must obtain ϵ higher utility than the N sector workers). Because the candidates for SPEs from Proposition 2 are inefficient, a tax rate closer to the first-best might generate efficiency enhancement for both sector's workers also when moving costs are taken into account. Hence, when ϵ is sufficiently small, an N majority will never choose the tax rate τ_N (and conversely a T majority will never choose τ_T). Then there are no SPEs in the model.

We can now summarize.

[14]Note that although this argument rules out other possible SPEs than those in Proposition 2, we do not claim that majority citizens will never vote in a way that implies occupational shifting. This becomes clear in the next paragraphs. Nevertheless, the argument in this paragraph is sufficient to rule out other SPEs than those in Proposition 2.

[15]Recall that marginal deviations, i.e. deviations that do not cause agents to shift occupation, do not exist in the SPEs in Proposition 2.

Proposition 3 *Suppose citizens (at any stage) can switch occupation at a cost $\epsilon > 0$. Then, the only candidates for equilibria are those in Proposition 2. If ϵ is sufficiently small there are no equilibria.*

It follows that the impossibility result holds even if the cost of switching occupation is infinitely small, while the inefficient equilibria in Proposition 2 exist only if the moving cost is sufficiently high.

2.5 Democracy and the Protection of Minority Interests

Although majority rule is a key ingredient in democratic theory, there is wide agreement that democracy cannot be defined by this property alone (see e.g. Dahl 1956, 1989). In particular, the protection of minority interests in constitutional design has been central at least since it was discussed by James Madison in Federalist No. 10, and Adams (1788) used the term "Tyranny of the majority". Mill (1859) discusses the limits of societal power further, and in current debates on democracy the following statement by Canon (1999, p. 339) is probably uncontroversial: "A central problem for representative democracy is to provide a voice for minority interests in a system that is dominated by the votes of the majority."

Thus, a natural requirement for a society to be termed democratic is that there exists a limit to how strongly a majority can suppress the interests of a minority. In terms of our model, one way to specify such a limit is to constrain how far the interests of a majority can be boosted at the costs a minority (or vice versa). Then, protection of minority interests may be specified as a requirement that

$$|U_j - U_{-j}| \leq k, \quad j \in \{N, T\}, \tag{28}$$

where $k \geq 0$ (and where $j = N$ implies $-j = T$ and vice versa). If $k = 0$, there is *absolute* protection of minority interests. In this case it can be readily verified that our impossibility result does not apply, since if the allocation of labor is first-best, then the only policy that a majority will choose which satisfies (28) is the first-best policy $\tau = \gamma$. In this situation there is also a continuum of other equilibria (i.e. all points on the segment $p = 1$ in Figure 1).

Focusing on the case of *non-absolute* protection of minority interests, however, we have the following:

Proposition 4 *Assume that the protection of minority interests is non-absolute, i.e.* $k > 0$*. Then, Proposition 2 applies identically.*

Proof. *Again using backward induction, note first that in the SPEs in Proposition 2, requirement (28) is satisfied, and thus those are still SPEs.*

Consider now the possibility of additional SPEs. Such equilibria must satisfy the arbitrage condition that utility of minority citizens and majority citizens are the same, i.e. $p = 1$*. Thus, for a given allocation of labor, from (25) there exists a unique tax rate in which* $p = 1$*. Denote this tax rate by* τ_a*.*

Consider first the case where $\tau_a \in [0, \tau_T\rangle$*. Any citizen prefers a higher tax rate than* τ_a*. Thus,* τ_a *can never constitute an SPE (again recall that we focus on SPEs in undominated strategies).*

Consider next the case where $\tau_a \in \langle\tau_N, 1]$*. Any citizen prefers a lower tax rate than* τ_a*. Thus,* τ_a *can never constitute an SPE.*

Consider then the case where $\tau_a \in \langle\tau_T, \tau_N\rangle$*. Recall that in this case the utility of any citizen in the traded sector is strictly decreasing in the tax rate, while the utility of any citizen in the non-traded sector is strictly increasing in the tax rate. Thus, a majority citizen would always prefer a marginal change in the tax rate. Such a tax change would introduce only a marginal difference in utility between majority and minority citizens, thus requirement (28) would not be violated. Therefore, when protection of minority interests is non-absolute, a tax rate in the interval* $\langle\tau_T, \tau_N\rangle$ *can never constitute an SPE.* ∎

Note again a key implication of free entry. Free entry means that any SPE must satisfy a standard arbitrage condition. In turn, this means that even when a majority can only marginally tilt policy in their preferred direction, the combination of (i) competitive markets, (ii) free entry, and (iii) democracy is inconsistent with allocative efficiency. Moreover, in the model above, also the possible SPEs are unaffected.

3 Generalization

In this section, we generalize our impossibility result that the combination of (i) competitive markets, (ii) free entry, and (iii) democracy is inconsistent with allocative efficiency.

Consider a continuum of identical agents $i \in [0, 1]$ who choose between two different activities N and T.[16] Let $\mathbb{I}_j$ denote the set of agents i who are in

[16] In the Appendix, we further consider a model with a continuum of activities.

activity j. Then, the factor allocations $\{l_N, l_T\}$ are $l_j = \int_{i \in \mathbb{I}_j} 1 \mathrm{d}i$, $j = N, T$. After choosing sector, a democratic policy choice is made. Let the scalar P denote policy and let $\mathbb{P}$ denote the policy space. The payoff U_i to an agent i depends on P and the agent's sector of occupation j, and is continuous in factor allocations:

$$U_i = U(P, l_N, l_T, j), \quad j \in \{N, T\}. \tag{29}$$

The actual choice of policy is restricted by the protection of minority rights $|U_j - U_{-j}| \leq k$, (and where again $j = N$ implies $-j = T$, and vice versa). Let $P = P^*$ denote the efficient policy where (i) competitive markets and (ii) free entry yield the socially efficient allocation $\{l_N^*, l_T^*\}$. In order not to have a degenerate problem we restrict attention to settings where neither sector is superfluous:[17]

Assumption 1: *$l_N^* > 0$ and $l_T^* > 0$.*

We also assume that agents in each of the two activities have conflicting interests over permitted policies. In particular this implies that at the efficient allocation $\{l_N^*, l_T^*\}$, agents in each sector have at least one policy that is strictly preferred to $P = P^*$ and that does not violate the protection of minority rights:

Assumption 2: *For agents in each activity $j = N, T$ there exists a subset of policies $\mathbb{P}_j \subset \mathbb{P}$ such that for any $P_j \in \mathbb{P}_j$ we have $U(P_j, l_N^*, l_T^*, j) > U(P^*, l_N^*, l_T^*, j)$ and $|U(P_j, l_N^*, l_T^*, j) - U(P_j, l_N^*, l_T^*, -j)| \leq k$.*[18]

As before, we restrict attention to SPEs in undominated strategies. A general proposition follows:[19]

Proposition 5 *Consider a situation where institutional components (i), (ii), (iii), and Assumptions 1 and 2 hold. Then, the socially efficient allocation $\{l_N^*, l_T^*\}$ is not an SPE.*

[17] Note that $P = P^*$ could be the absence of policy, as would be the case if the well-known conditions for perfect competition hold. Alternatively, in the presence of market failures $P = P^*$ would be the optimal policy that corrects for these. In our baseline model, for instance, $P = P^*$ is the policy of $\tau = \gamma$.

[18] Because P^* is Pareto optimal, $\mathbb{P}_N \cap \mathbb{P}_T = \emptyset$.

[19] Again, should the mass of agents in each activity be identical, voters in one pre-specified activity j will be decisive.

Proof. *Consider the allocation* $l_N = l_N^*$ *and* $l_T = l_T^*$*. If* $P = P^*$*, then by definition of this policy, free entry implies that no agent would regret their choice of activity. However, from Assumption 2, agents in the majority activity* j *strictly prefer a different permitted policy* $P \in \mathbb{P}_j$*. Hence, under our restriction to undominated strategies, the policy choice* P^* *cannot be part of an SPE. If* $P \in \mathbb{P}_j$ *is implemented, any agent in the minority activity* $-j$ *will regret their choice of activity. Thus,* $\{l_N^*, l_T^*\}$ *is not an SPE.* ■

Agents anticipate that if the allocation is $\{l_N^*, l_T^*\}$, no agent will vote for the efficient policy P^*. As there is free entry and perfect competition, the efficient allocation $\{l_N^*, l_T^*\}$ can never be an SPE. Proposition 5 shows that Assumptions 1 and 2 are sufficient[20] for the impossibility result and that this result extends well beyond our baseline model. In our baseline model (as well as in our introductory example), it can easily be verified that institutional components (i)-(iii) and Assumptions 1 and 2 are satisfied.[21]

The impossibility result above shows that $\{l_N^*, l_T^*\}$ is not part of an SPE. Following from the logic above, a candidate for an SPE $\left\{\hat{l}_N, \hat{l}_T\right\}$ has to satisfy the criteria in the following proposition:

Proposition 6 *An allocation* $\left\{\hat{l}_N, \hat{l}_T\right\}$ *together with a policy* $\hat{P}$ *constitutes an SPE if and only if: a)* $U(\hat{P}, \hat{l}_N, \hat{l}_T, j) \geq U(\hat{P}, \hat{l}_N, \hat{l}_T, -j)$*, (where* j *denotes the majority activity and where there is strict inequality only when the minority activity is empty, i.e.* $\hat{l}_j = 1$ *and* $\hat{l}_{-j} = 0$*) and there exists no policy* P_j *such that both conditions b)* $\left|U(P_j, \hat{l}_N, \hat{l}_T, j) - U(P_j, \hat{l}_N, \hat{l}_T, -j)\right| \leq k$ *and c)* $U(P_j, \hat{l}_N, \hat{l}_T, j) > U(\hat{P}, \hat{l}_N, \hat{l}_T, j)$ *are met (where* k *is set to infinity when the minority activity is empty, i.e.* $\hat{l}_j = 1$ *and* $\hat{l}_{-j} = 0$*).*

Proof. *Condition a) ensures that no agent regrets the choice of activity. Condition b) and c) ensure that no majority agent strictly prefers another permitted policy.* ■

The last proposition clarifies what is required for a combination of allocation and policy to constitute an SPE. Note that an allocation is part of an

[20] Trivially, if Assumption 1 is violated for example by $l_N^* = 0$, then the socially efficient allocation is a corner solution with all agents in the T-activity, and the efficient policy $P = P^*$ would be an SPE. Also trivially, if $P = P^*$ is the majority groups preferred policy, in violation of Assumption 2, the efficient allocation would be an SPE.

[21] The impossibility result applies also in circumstances where there is free entry and where the minority is most influential, as argued by Olson (1965) (and further analyzed by Esteban and Ray, 2001). The only modification is that now the policy will be shifted in the direction of the minority sector.

SPE only when the majority cannot use policy to achieve any gains. Condition b) captures how protection of minority rights may limit the policy space. Condition c) captures that in an SPE no policy deviation can increase utility for agents in the majority activity. In the baseline model in Section 2, we had either one or two SPEs. In that model it was c) rather than b) which ensured that no majority agent strictly preferred another policy. The reason for this was that tax levels close to zero or one both generated inefficiencies that outweighed any gains for the majority from tilting factor prices in their favor.

Heterogeneous productivities The impossibility result is also robust to letting agents differ by individual productivity. Let the agents have productivity $a_{ji} > 0$ in activity j, with income in each activity proportional to productivity. Assuming that utility U is measured in consumption equivalents, payoffs to agent i in each activity j now also depend on productivity:[22]

$$U_i = a_{ji} U(P, l_N, l_T, j), \quad j \in \{N, T\}, \tag{30}$$

where the factor allocations are given by: $l_j = \int_{i \in \mathbb{I}_j} a_{ji} \mathrm{d}i$, $j = N, T$. Here again $\mathbb{I}_j$ denotes the subset of agents i who are in activity j. Without loss of generality, let i be ordered such that $\frac{\partial \frac{a_{Ni}}{a_{Ti}}}{\partial i} \geq 0$, implying that agent $i = 0$ has the highest comparative advantage in activity T, while agent $i = 1$ has the highest comparative advantage in activity N. In order not to introduce discontinuities, we also assume that the set of $\frac{a_{Ni}}{a_{Ti}}$ is connected.

Under the assumed ordering of i, we can denote the efficient allocation of workers by i^* and define efficient factor allocations $\{l_N^*, l_T^*\}$, where

$$l_T^* = \int_{i < i^*} a_{Ti} \mathrm{d}i, \quad l_N^* = \int_{i \geq i^*} a_{Ni} \mathrm{d}i.$$

Now the proposition still holds as long as $|a_{ji^*} U(P_j, l_N^*, l_T^*, j) - a_{-ji^*} U(P_j, l_N^*, l_T^*, -j)| < k$. With heterogeneous agents we can now be sure that if $P = P^*$, agents on *both* sides of i^* prefer to be in the majority activity, which implies that some minority activity agent regrets his or her choice.

[22] All results go through if the true utility is a monotone transformation of $a_{ji} U(P, l_N, l_T, j)$.

4 Further Applications

In this section we apply our model to investigate two topics that have received considerable attention in the literature, and where we believe our analysis is particularly relevant. In both applications, we start out from our basic model in Section 2 and modify some of the assumptions. First, we depart from institutional component (i) competitive markets and study how coordinated wage setting (modeled in a way that mimics the type of labor market institutions seen in Scandinavian countries) affects the political economic equilibrium. Then we study how our approach sheds new light on the penomenon known as "Dutch disease", where possible distortions to factor allocations are key.

4.1 Scandinavian Labor Market Institutions and Coordinated Wage Setting

Competitive markets is one out of three institutional components in our impossibility result. We now consider a framework where, as in the Scandinavian countries, labor market institutions are more centralized than what they are in countries such as France, the UK or the US. In the Scandinavian countries, particularly in Sweden and Norway, there is coordinated wage setting with wage equalization across sectors. Originating in the 1920s and 1930s, as emphasized by Moene and Wallerstein (1995, p. 188), "the leading proponents of centralized bargaining were not the unions at all, but employers." Over time, this system was embraced by the unions, and compared to what is the case in other countries (p. 190)

> "The Nordic unions are unique, however, in extending the principal of 'equal pay for equal work´ from one industry to the entire economy, and then moving beyond the demand for 'equal pay for equal work´ toward the goal of 'equal pay for all work'."

The Scandinavian labor market institutions have been argued to have favorable effects in that they prevent wage increases for one group from inflicting negative externalities on others, see Calmfors (1993) for an overview of these effects. Here we argue that this institutional architecture not only has the labor market effects pointed out in the earlier literature, but also that it shapes the political incentives regarding the size of the public sector, reducing incentives for the majority to vote for a too small or a too large public sector.

The Scandinavian countries are often characterized by their welfare state with the public sector playing a key role in the economy, although as emphasized by e.g. Acemoglu (2019) "in Scandinavia, shared prosperity was achieved not through redistribution, as is commonly assumed, but as a result of government policies and collective bargaining." Indeed, compared to e.g. France, central government spending is considerably lower despite GDP per capita being considerably higher; in 2017 GDP per capita in Sweden was 28% higher than in France, while central government spending stood at 49,6% of GDP compared to its 56,8% of GDP in France.[23]

We thus consider an institutional environment with nationally coordinated wage setting, imposing an equal pay constraint. We model this in a highly stylized and simple manner: no firm is allowed to hire workers at lower wages than other firms in the economy. Importantly, as consistently emphasized in the literature on the Scandinavian model, although there is coordinated wage determination, much emphasis is placed on competitive product markets. In the model, we thus continue to assume that there is perfect competition in product markets, implying that in equilibrium there will still be zero profits. In such a situation there may be unemployment, as sectoral wages may not respond to movements in the sectoral composition of the labor force, as summarized by l_N, or to movements in labor demand, as summarized by n_j. Note, however, that there cannot be unemployment in both sectors at once: with exogenous labor supply this would again imply that all firms prefer, and could hire, workers at zero wages.[24] Thus we can rule out an equilibrium with unemployment in both sectors. If there is unemployment in equilibrium, then:

$$\text{either } \eta_N < 1 \text{ and } \eta_T = 1, \text{ or } \eta_N = 1 \text{ and } \eta_T < 1. \tag{31}$$

Zero equilibrium unemployment is equivalent to $\eta_N = \eta_T = 1$. Moreover, given that wages are positive and equal across sectors, and that profits are zero, the

[23] In Norway, which has a GDP per capita close to twice that of France, the central government spending was at 48,8% of GDP. Thus it was lower than in France even though Norway has a USD 200.000 per capita petroleum fund, which pushes government spending up considerably since the annual expected real return of 3% on this fund enters into the central government budget.

[24] Wages and prices would then equal zero, with the implication that agents could get goods for free by hiring labor at zero cost, and would thus employ unlimited amounts of labor. But this is not consistent with unemployment.

only wage-price combination consistent with equilibrium under equal pay is

$$w_N = p = w_T = 1. \tag{32}$$

At earlier stages of the game, when citizens make their occupational choice, the only wage and price expectations consistent with equilibrium, are those given by (32). Likewise, when citizens in the next stage vote over taxes, they do so in awareness that they cannot affect the relative wage. Instead, what may vary with taxation is the sectoral employment rate, $\eta_j \equiv n_j/l_j$, in one of the sectors. Employment matters to the voter, both because any variation in his or her sector's employment rate will carry directly over to his or her disposable income, and because higher employment implies greater production and provision of goods and services. Taking these preliminaries into account, we now solve to find the possible SPEs using backward induction.

From (13) and $p = 1$, it follows that equilibrium in the goods market again requires

$$\frac{n_N}{n_T} = \frac{\alpha + \tau\beta}{\beta\,(1-\tau)}. \tag{33}$$

A higher tax rate shifts demand in favor of non-traded relative to traded sector employment. Intuitively, because relative wages and prices are constant, relative quantities, and thus sectoral employment levels, must adjust instead. Note, however, that the sectoral employment ratio is also constrained by the predetermined labor supplies. Hence, the goods and labor markets clear when (33) holds subject to $n_N \leq l_N$ and $n_T \leq l_T = 1 - l_N$. Moreover, equation (33) implies that for any sectoral composition of the workforce, summarized by l_N, there is a unique tax rate, which we denote $\widetilde{\tau}\,(l_N)$, that is consistent with full employment. After inserting $n_N = l_N$ and $n_T = 1 - l_N$ into (33), we find the full-employment tax rate as

$$\widetilde{\tau}\,(l_N) = \frac{l_N\,(\beta+\alpha) - \alpha}{\beta}. \tag{34}$$

We then have the following relationship between taxation and unemployment for a given workforce composition:

Lemma 2 *(i) If (and only if) $\tau = \widetilde{\tau}\,(l_N)$, then $n_N = l_N$ and $n_T = l_T$. (ii) If $\tau < \widetilde{\tau}\,(l_N)$, then $n_N = \frac{\alpha+\tau_C\beta}{\beta(1-\tau)}\,(1-l_N) \leq l_N$ and $n_T = l_T$. (iii) If $\tau > \widetilde{\tau}\,(l_N)$, then $n_N = l_N$ and $n_T = \frac{\beta(1-\tau)}{\alpha+\tau\beta} l_N < l_T$.*

Proof. *See Appendix.* ■

The economic content of this lemma is intuitive. If the tax rate is lower than the full employment tax rate, then demand for non-traded sector labor is insufficient for all non-traded sectors workers to be employed. Likewise, if the tax rate is higher than the full employment tax rate, then demand for traded sector labor is insufficient for full employment in this sector.

Before proceeding, we note that if $l_N = l_N^o \equiv 1 - \beta$, then $\widetilde{\tau}\left(l_N^o\right) = \frac{(1-\beta)(\beta+\alpha)-\alpha}{\beta} = \gamma$. That is, if the initial labor force composition is consistent with the first-best allocation of resources, then the full-employment tax rate is consistent with the first-best provision of public goods.

The optimal tax rates as seen from the perspectives of workers in the non-traded and the traded sector under centralized labor market institutions, again denoted τ_N and τ_T respectively, will depend on the composition of the workforce. Hence, we are seeking to characterize two tax functions $\tau_N\left(l_N\right)$ and $\tau_T\left(l_N\right)$.

Inserting from (32) for wages and prices in (14), and taking into account that tax rates may affect employment levels, i.e. $n_N = n_N\left(\tau\right)$ and $n_T = n_T\left(\tau\right)$, the utility for non-traded and traded sector workers, respectively, follows as

$$U_N = \Phi\left(1-\tau\right)^{1-\gamma}\tau^{\gamma}\left(\frac{n_N\left(\tau\right)}{l_N}\right)^{1-\gamma}\left(n_N\left(\tau\right)+n_T\left(\tau\right)\right)^{\gamma}, \tag{35}$$

$$U_T = \Phi\left(1-\tau\right)^{1-\gamma}\tau^{\gamma}\left(\frac{n_T\left(\tau\right)}{1-l_N}\right)^{1-\gamma}\left(n_N\left(\tau\right)+n_T\left(\tau\right)\right)^{\gamma}. \tag{36}$$

Before turning to a general characterization of the tax functions for any l_N, we start with the special case where l_N is such that the first-best tax rate is consistent with full employment:

Lemma 3 *If the workforce composition, summarized by l_N, is such that the full-employment tax rate is $\widetilde{\tau} = \gamma$, then the preferred tax rate for any worker is $\tau_N = \tau_T = \widetilde{\tau} = \gamma$.*

Proof. *See Appendix.* ■

While at first sight this might seem like a special case, our subsequent analysis will in fact show that it constitutes part of the unique SPE. To explain this we first provide a full characterization of each group's preferred tax policy for any l_N.

Combining (35) and (36) with (33) will give the indirect utility functions over taxes, U_N^N and U_T^T. However, because n_N and n_T are constrained by

$n_N \leq l_N$ and $n_T \leq 1 - l_N$, these indirect utility functions will consist of three distinct segments depending on the tax rate, τ, relative to the predetermined work-force composition as summarized by l_N. For instance, whenever $\tau < \widetilde{\tau}(l_N)$, there is unemployment among N-workers and full employment among T-workers. Hence, a marginal change in taxes will leave n_T unchanged but affect n_N. Vice versa, whenever $\tau > \widetilde{\tau}(l_N)$, there is full employment among N-workers and unemployment among T-workers. In this case, a marginal change in taxes will affect n_T but leave n_N unchanged. When $\tau = \widetilde{\tau}(l_N)$, there is full employment in both sectors. A marginal increase in taxes will then reduce n_T but leave n_N unchanged, while a marginal reduction in taxes will leave n_T unchanged but reduce n_N.

Taking these considerations into account, we have the following lemma:

Lemma 4 *The preferred tax rates for N-workers, τ_N, and for T-workers, τ_T, satisfy:*

$$\tau_N(l_N) = \begin{cases} \underline{\tau}_N & \text{if } l_N < \underline{\lambda}_N \\ \widetilde{\tau}(l_N) = \frac{l_N(\beta+\alpha)-\alpha}{\beta} & \text{if } \underline{\lambda}_N \leq l_N \leq 1 \end{cases},$$

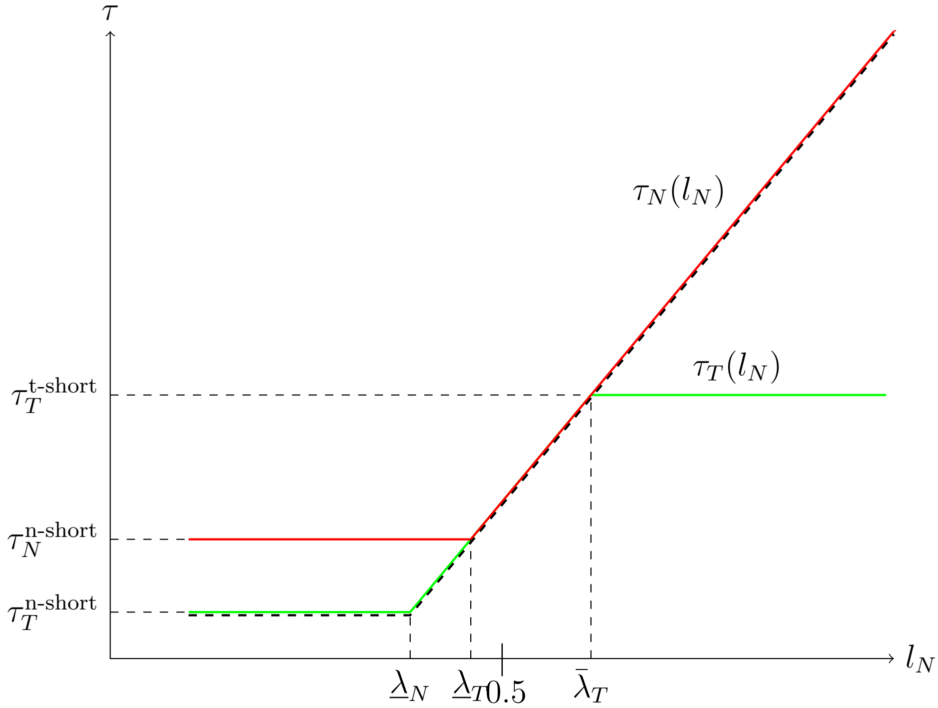
$$\tau_T(l_N) = \begin{cases} \underline{\tau}_T & \text{if } l_N < \underline{\lambda}_T \\ \widetilde{\tau}(l_N) = \frac{l_N(\beta+\alpha)-\alpha}{\beta} & \text{if } \underline{\lambda}_T \leq l_N \leq \overline{\lambda}_T \\ \overline{\tau}_T & \text{if } \overline{\lambda}_T < l_N \end{cases}.$$

Proof. *See Appendix.* ■

For both N-workers and T-workers there is a lower bound on l_N below which both types of workers accept unemployment. For trade workers there is also an upper bound. To see the consequences of this lemma, consider Figure 2.

Here the green curve shows the preferred tax for traded workers while the red curve is the preferred tax for non-traded workers. They overlap in the interval $[\underline{\lambda}_T, \bar{\lambda}_T]$. In this interval both groups of workers prefer a tax rate that is consistent with full employment. When l_N is sufficiently low, both traded and non-traded workers prefer a tax that gives unemployment among traded workers. The reason is that public goods are so valuable that setting the tax close to zero is never attractive. When l_N is high, non-traded workers will always want a tax that assures full employment. The reason is that a sufficiently high tax removes unemployment among them and improves their purchasing power. Traded workers will never want a tax rate higher than $\bar{\tau}_T$. A higher tax lowers purchasing power while increasing employment in the

Figure 2: Tax reaction function with equal wages



other sector. In the figure we have also indicated $l_N = 0.5$. When $l_N < 0.5$, the median voter works in the traded sector and has a preferred tax rate given by the green line $\tau_T\,(l_N)$. When $l_N > 0.5$, the median voter works in the non-traded sector and has a preferred tax given by the red line $\tau_N\,(l_N)$. The overall tax response function is therefore the dashed black line. For l_N until $\underline{\lambda}_T$, the tax is $\underline{\tau}_T$ and there is unemployment among non-traded workers. From $\underline{\lambda}_T$ and onward, the tax assures full employment in both sectors. First because traded workers prefer it, and thereafter because non-traded workers prefer it.

We now turn to the first stage of the game, where agents choose which sector to enter. As under competitive labor markets, an equilibrium in occupational choice must satisfy two conditions: (i) citizens are indifferent between entering either sector, and (ii) it is not possible for any single citizen to obtain higher utility by switching sector, given the effects on future income and taxation.

Condition (i) implies $U_N = U_T$, where utilities are given by equations (35) and (36). It immediately follows that citizens will choose their occupation so that the expected employment rates in the two sectors are equalized, $\eta_N = \eta_T$. This stark equilibrium condition follows from the fact that because wages are equalized and unemployment risk is shared within each sector, differences in income are entirely driven by differences in sectoral employment rates. Hence, any expected difference in sectoral employment rates will motivate all citizens to join the sector where employment is highest. Thus, expected employment rates must be equal in equilibrium. By combining $\eta_N = \eta_T$ with the market clearing condition (33) and solving with respect to l_N, we obtain

$$l_N = \frac{\alpha + \tau\beta}{\beta + \alpha}. \tag{37}$$

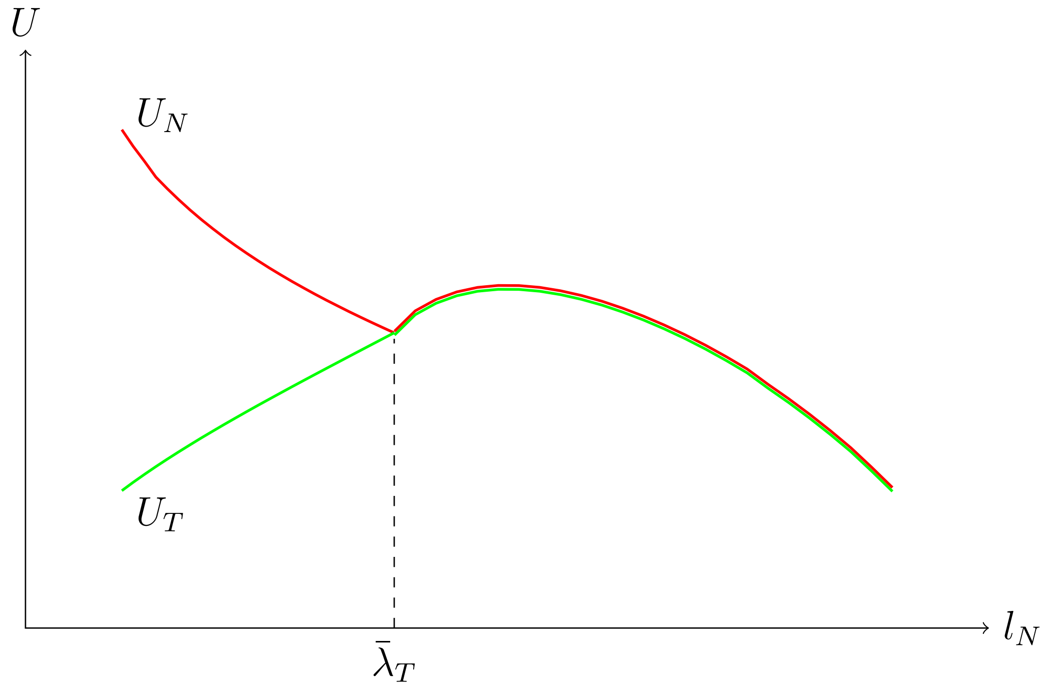
Intuitively, citizens choose sectoral specialization based on the expected employment outlook. As the relative employment rate $(\frac{n_N}{n_T})$ is determined by taxation, so is occupational choice. Note further that this condition is equivalent to the expression for the full-employment tax rate $\widetilde{\tau}(l_N)$. This implies that, given the tax policy function citizens expect to prevail in the future, they will choose sectors so that this tax function yields full employment.

Condition (ii) implies that in an equilibrium, no citizen may raise his or her individual utility by unilaterally switching to a different sector. Given that occupational choice ensures $\tau = \widetilde{\tau}(l_N)$, we may insert $\eta_N = \eta_T = 1$ in (35) and (36), with the result that in equilibrium the utility of any citizen must obey

$$U_j(\widetilde{\tau}(l_N)) = \Phi(1 - \widetilde{\tau}(l_N))^{1-\gamma}\,\widetilde{\tau}(l_N)^{\gamma},\ j = \{N, T\}.$$

This utility function is single-peaked with maximum at $\widetilde{\tau}(l_N) = \gamma \Leftrightarrow l_N = \alpha + \gamma = l_N^o$. Hence, for any workforce allocation such that $l_N < l_N^o$, citizens would wish they had moved into sector N. Likewise, for any workforce allocation such that $l_N > l_N^o$, citizens would wish they had moved into sector T. In contrast, if $l_N = l_N^o$, no worker would regret his or her sectoral choice. It follows that $l_N = l_N^o$ is the unique equilibrium workforce composition, with the associated equilibrium tax rate $\tau = \gamma$. Figure 3 illustrates the result. In the figure the utilities are derived after inserting for the tax reaction function from Figure 2. For $l_N < \underline{\lambda}_T$, the tax is $\underline{\tau}_T$, and there is unemployment in the traded sector. Hence, $U_N > U_T$, and workers would want to move from traded to non-traded sector. This is true until $l_N < \underline{\lambda}_T$. For $l_N > \underline{\lambda}_T$, there is no unemployment in either sector and equal wages, hence $U_N = U_T$. There is thus no wage premium in either sector. Fully rational agents seeing through general equilibrium effects and endogenous tax choice will, in spite of equal wages, allocate themselves between the sectors so that all agents achieve maximum utility under the full employment constraint. This allocation is nothing but the first-best allocation

Figure 3: Utility with equal wages and tax set by median voter.



where $l_n = \alpha + \gamma$ and $\tau = \gamma$.

The following proposition summarizes (proof in text):

Proposition 7 *With centralized labor institutions, the unique political equilibrium is the first-best allocation with* $l_N = l_N^o \equiv 1 - \beta$, $l_T = l_T^o \equiv \beta$ *and* $g = \tau = \gamma$.

Figure 3 helps convey the intuition behind Proposition 7. In the figure we have drawn the indirect utility for N- and T-workers following from the configuration illustrated in Figure 2, where the median voter T-worker sets $\tau = \underline{\tau}_T$ when $l_N < \underline{l}_N^*$. When $l_N \geq \underline{l}_N^*$, the T-worker prefers $\tau = \tilde{\tau}$, and when the N-worker becomes the median voter also she prefers $\tau = \tilde{\tau}$. When the full employment tax rate, $\tau = \tilde{\tau}(l_N)$, is set, the utility is the same for both groups of workers, and the red and the green line coincide. When there is unemployment among T-workers, $\tau > \tilde{\tau}(l_N)$, then $U_N > U_T$ (in the figure where $l_N < \underline{l}_N^*$). Clearly any l_N where $U_N > U_T$ cannot constitute an SPE. The remaining candidates for an SPE are thus those found where $U_N = U_T$. This continuum is characterized by the no-arbitrage condition being fulfilled. This schedule has a maximum. If all agents are perfectly individually rational this maximum is the only SPE. The intuition is as follows: to the left of the maximum, individual utility would go up for all if l_N was larger. One worker in the T-sector would regret his choice and would wish he had entered the N-sector instead, because he alone changing sector would have increased his utility, given the allocation of all other agents. To the right of the maximum, utility would go up for all if l_N was smaller. Similarly, individual utility would go up for an agent shifting from the N-sector to the T-sector. The implication of perfect rationality is, in this model, that agents are non-atomistic and appreciate the utility gains resulting from efficiency-enhancing general equilibrium effects.[25]

A more plausible assumption might be that agents do not consider the general equilibrium effects of their individual actions. If this is the case, the only restriction on occupational choice is the no-arbitrage condition that utility is equal across sectors. The socially optimal allocation with the corresponding full-employment tax rate still is an equilibrium, but there will now exist a continuum of other SPEs as well. These include SPEs that are, from a social point of view, inferior also to the two equilibria under competitive markets.

4.2 The Dutch Disease

Distortions to the allocation of factors of production are central to several economic debates. One particular issue that has received much attention over the past decades is the so-called Dutch disease. A large literature, starting with van Wijnbergen (1984) and Krugman (1987), and continuing with the model in Sachs and Warner (1995), argues that natural resource windfalls may in fact lead to lower welfare by distorting factor allocations. In these theories resource windfalls contracts the traded sector and expands the non-traded sector, which comes with a cost since it is assumed that the traded sector generates positive externalities in the form of learning by doing, while the non-traded sector does not.[26] Our mechanism can also lead to a Dutch disease. But the reason is political, rather than purely economic.

Consider thus our baseline model of competitive markets, free entry, and democracy, extended to study the same situation as in the Dutch disease literature, namely that a resource windfall is an exogenous amount of traded sector goods that is distributed lump-sum to all citizens as in van Wijnbergen

[25] Note that in deriving the equilibria under competitive markets, we did not require that agents internalize general equilibrium effects when entering an occupation.

[26] For a review of the literature on the resource curse in general, and the theories of the Dutch disease in particular, see van der Ploeg (2011).

(1984), Krugman (1987), and Sachs and Warner (1995). Denote these resource rents by R, and assume that they arrive before agents enter a sector. Taking into account full employment, the income net of taxes of an agent in sector $j \in \{N, T\}$ is given by $(1-\tau)(w_j + R)$.

From (6) and (7), the public sector budget constraint now reads

$$g = \tau \left(l_N + \frac{l_T + R}{p} \right), \tag{38}$$

while the consumption demands are

$$c_{N,j} = \frac{\alpha}{(\alpha+\beta)\, p} (1-\tau)(w_j + R), \quad j \in \{N, T\}, \tag{39}$$

and

$$c_{T,j} = \frac{\beta}{\alpha+\beta} (1-\tau)(w_j + R), \quad j \in \{N, T\}. \tag{40}$$

Given these preliminaries, we have the following proposition:

Proposition 8 *The higher are the resource rents R, the less likely is a unique SPE where the median voter is a traded sector worker (in the sense that the set of parameters where this is the case is smaller). For a sufficiently high R, the situation with a unique SPE where the median voter is a traded sector worker is not possible.*

Proof. *See Appendix.* ■

The intuition for this proposition is that when the economy receives resource rents, the preferred tax rate for traded sector workers implies a higher production of non-traded relative to traded goods. The reason is that, in standard fashion, income has increased as a direct result of the resource rents. The natural resource rents come in the form of more freely available traded goods (or more foreign exchange with which to buy these goods), and when both goods are normal, then also traded sector workers prefer to consume more private and public non-traded goods. This implies, however, that more labor will be employed in the non-traded sector, and that less will be employed in the traded sector. By implication, the unique equilibrium where the median voter is a traded sector worker is less likely to emerge. Thus, the economy may shift from a situation where the public sector is too small to a situation where the public sector is too large.

This possible Dutch disease has the same symptom as in the previous literature initiated by van Wijnbergen (1984) and Krugman (1987), namely that the non-traded sector in general, and the public sector in particular, become too large from the point of view of society. But the mechanism is very different. In our setting it is not learning-by-doing externalities that underlie the problem. The problem is that the traded sector workers become less numerous, and thus less politically powerful. They may then lose their influence over policy, which from the point of view of society, is a force toward a small public sector. Thus, we may shift toward a situation where the public sector becomes too large rather than too small. In the sense that it is a political economy mechanism that produces a Dutch disease, our paper is also related to Robinson, Torvik and Verdier (2006, 2014). The difference is that in those papers an incumbent ruler implements a too short-sighted policy with too many public employees to increase his re-election probability, while in our paper it is the traded sector workers who endogenously become less politically powerful relative to the non-traded sector workers.

5 Conclusion

In this paper we have provided a fundamental result, namely that under fairly general conditions, the combination of (i) competitive markets, (ii) free entry, and (iii) democracy, is inconsistent with allocative efficiency. Key to this impossibility result is that, in general equilibrium, allocations affect not only prices, but also policies. The main innovation of our approach is that agents are free to choose in which activity to enter, which, in turn, has the implication that political preferences become endogenous to entry. Agents must then take into account that entry determines payoffs not only in the traditional sense, but also that entry affects the political power of different groups, and thus, equilibrium policy. The requirement that arbitrage conditions must be fulfilled guarantees an equilibrium that cannot be socially optimal, conditional on the requirement that policy responds to political power. We have also shown that this insight has implications for widely studied economic phenomena such as the size of the public sector, the Dutch disease, and for theories of how different institutions, in our case labor market institutions, affect factor allocations in political economic general equilibrium.

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Appendix: Model with a Continuum of Sectors

In Section 2 we developed a two-sector model where the government purchases goods or services from one of the sectors only. We now generalize the analysis by studying a model with a continuum of sectors as in Dornbusch, Fischer, and Samuelson (1980) and where the government potentially purchases the output from all sectors.

The sectors are distributed on the unit interval $i \in [0,1]$. The mass of workers is normalized to unity. Let $l(i)$ denote the mass of workers in sector i. Full employment then implies

$$\int_{i=0}^{1} l(i)\,\mathrm{d}i = 1.$$

Productivity in each sector is constant and equal to one. Output then equals employment and is used for private and government consumption:

$$l(i) = c(i) + G \cdot g(i), \tag{A-1}$$

where $c(i)$ is private purchases and $G \cdot g(i)$ is government purchases from sector i.

The government purchases a share $g(i)$ of its total consumption G from each sector i, hence $\int_{i=0}^{1} g(i)\mathrm{d}i = 1$. The sectors are indexed such that $g'(i) > 0$. For later purposes, note that the average g equals unity (because the sectors are distributed on the unit interval). The resulting budget constraint for the government is

$$\tau Y = G \int_{i=0}^{1} p(i)\, g(i)\,\mathrm{d}i, \tag{A-2}$$

where $p(i)$ is the price of goods from sector i, τ is the tax rate and Y is aggregate private income:

$$Y = \int_{i=0}^{1} l(i)\, p(i)\,\mathrm{d}i. \tag{A-3}$$

As the mass of workers is unity, Y is also average income.

A citizen can only be employed in one sector. The income of a citizen working in sector j, later referred to as worker j, is $p(j)$. Let $c_j(i)$ denote worker j's consumption of goods from sector i. The utility of worker j is

$$U_j = (1-\gamma)\int_{i=0}^{1} \ln(c_j(i))\mathrm{d}i + \gamma \ln G, \tag{A-4}$$

which implies that the budget share spent on each private good is independent of j's income. Since citizens only differ by the sector in which they work (and thus potentially differ by income), it follows that all citizens have equal expenditure shares. Hence,

$$c_j(i) = \frac{p(j)}{Y}c(i), \tag{A-5}$$

where $\frac{p(j)}{Y}$ is the relative income of worker j. It also follows that total spending on each sector's output is

$$c(i)\,p(i) = Y(1-\tau). \tag{A-6}$$

We now turn to characterizing each citizen's preferred size of government, G, for any given occupational choices. For any given allocation of workers, the utility of a worker in sector j may be written as

$$\begin{aligned} U_j &= (1-\gamma)\left(\int_{i=0}^{1} \ln\left(c(i)\frac{p(j)}{Y}\right)\mathrm{d}i\right) + \gamma\ln G \\ &= (1-\gamma)\int_{i=0}^{1} \ln(c(i))\,\mathrm{d}i + \gamma\ln G - (1-\gamma)\ln\frac{Y}{p(j)}, \end{aligned}$$

where we in the first line have applied equation (A-5). Equation (A-3) and (A-6) imply that $Y = \int_{i=0}^{1} l(i)\,Y(1-\tau)/c(i)\,\mathrm{d}i$, while (A-6) implies $p(j) = \frac{Y(1-\tau)}{c(j)}$. Hence, $\frac{Y}{p(j)} = c(j)\int_{i=0}^{1}\frac{l(i)}{c(i)}\mathrm{d}i$. Utility is therefore given by

$$U_j = (1-\gamma)\int_{i=0}^{1} \ln(c(i))\,\mathrm{d}i + \gamma\ln G - (1-\gamma)\ln\left(c(j)\int_{i=0}^{1}\frac{l(i)}{c(i)}\mathrm{d}i\right).$$

When the allocation of workers is fixed, it follows from (A-1) that the effect of government size on each $c(i)$ is $\mathrm{d}c(i) = -g(i)\,\mathrm{d}G$. The effect of G on worker j's utility is therefore given by

$$\begin{aligned} \mathrm{d}U_j &= \left(-(1-\gamma)\int_{i=0}^{1}\frac{g(i)}{c(i)}\mathrm{d}i+\frac{\gamma}{G}\right)\mathrm{d}G \\ &+ (1-\gamma)\left[\frac{g(j)}{c(j)}-\frac{\int_{i=0}^{1}\frac{l(i)g(i)}{c(i)^2}\mathrm{d}i}{\int_{i=0}^{1}\frac{l(i)}{c(i)}\mathrm{d}i}\right]\mathrm{d}G. \qquad \text{(A-7)}\end{aligned}$$

We now impose that in the first stage of the game, where citizens choose their occupation, there is free entry. As in the main text, an equilibrium with free entry must have the property that $p(i) = 1$ for all i. It follows from (A-3) that $Y = 1$, and thus from (A-2) that $\tau = G$. Equation (A-6) then implies that $c(i) = 1 - G$ for all i, which we can insert into equation (A-7) to obtain

$$\mathrm{d}U_j = \frac{1}{1-G}\left[\frac{\gamma}{G}-1+(1-\gamma)\left(g(j)-\int_{i=0}^{1}l(i)\,g(i)\,\mathrm{d}i\right)\right]\mathrm{d}G.$$

Next, we note that $c(i) = 1 - G$ and (A-1) imply

$$l(i) = 1 - G + g(i)\,G. \qquad \text{(A-8)}$$

It follows that

$$\mathrm{d}U_j = \frac{1}{1-G}\left[\frac{\gamma}{G}-1+(1-\gamma)\left(g(j)-1+G-G\int_{i=0}^{1}g(i)^2\,\mathrm{d}i\right)\right]\mathrm{d}G. \qquad \text{(A-9)}$$

The square bracket in (A-9) is continuously decreasing in G. Therefore, for each worker j, there is only one G that satisfies the first-order condition $dU_j/dG = 0$. This G constitutes a global optimum for worker j because any intermediate value of G is superior to both border values 0 and 1. Hence, if we let j^* denote the sector of a citizen who considers a given $G \in (0,1)$ as optimal, the following must hold:

$$0 = \frac{\gamma}{G}-1+(1-\gamma)\left(g(j^*)-1+G-G\int_{i=0}^{1}g(i)^2\,\mathrm{d}i\right). \qquad \text{(A-10)}$$

Note that (A-9) implies $\mathrm{d}U_j$ is monotonically increasing in $g(j)$. We can therefore define a function $h(G)$ that traces out how j^* in (A-10) depends on G:

$$j^* = h(G) \equiv g^{-1}\left(\left(1-\frac{\gamma}{G}\right)\frac{1}{1-\gamma}+1+G\mathrm{V}_g\right),\ h'(G) > 0. \qquad \text{(A-11)}$$

Here V_g is the variance of g

$$V_g = \int_{i=0}^{1} g\,(i)^2\,\mathrm{d}i - 1.$$

To be clear, $h'(G) > 0$ means that worker j's preferred G is increasing in j. Thus, the higher is a worker's sector's share $g(j)$ in government consumption, the higher G does the worker prefer.

From equation (A-10), we note that no worker wants zero government consumption:

$$h\,(G) = 0 \iff G = \underline{G} > 0. \tag{A-12}$$

A political equilibrium requires that the median voter does not want to alter the size of government. Thus $m = j^*$, where m denotes the sector of the median voter.

We next turn to characterizing the sector of the median voter. By definition, this sector follows from $\int_{i=0}^{m} l\,(i)\mathrm{d}i = 1/2$. Equation (A-8), which followed from free entry and market clearing, implies that whenever $G > 0$, $l'(i) > 0$. Hence, because there is a unit mass of workers, it follows that $m > 1/2$ for positive G. Moreover, the higher is G, the higher is $l'(i) > 0$, and thus the higher is the index m of the median voter. The intuition is simply that when G is high, sectors that produce a high share of government consumption demand more labor. With free entry, more citizens will then choose to enter those sectors.

We can now define how m depends on G. By combining $\int_{i=0}^{m} l\,(i)\mathrm{d}i = 1/2$ with (A-8), we obtain the relationship

$$m\,(G) = \mathrm{argsolve}_m \left[\int_{i=0}^{m} (1 - G) + g\,(i)\,G\mathrm{d}i = 1/2 \right],$$

which is equivalent to

$$m(G) = \mathrm{argsolve}_m \left[m\,(1 - G) + G \int_{i=0}^{m} g(i)\mathrm{d}i = 1/2 \right]. \tag{A-13}$$

We note immediately that m is less than one even if $G = 1$. Hence, $m \in [1/2, \bar{m}]$, where $\bar{m}$ is the median sector i in the distribution $g\,(i)$. Because i is continuous, $\bar{m} < 1$.

Implicit derivation of (A-13) implies that

$$m'(G) = \frac{m - 1/2}{Gg(m) - G + 1}\frac{1}{G} > 0 \text{ since } m > 1/2, G > 0.$$

The two functions h from equation (A-11) and m from equation (A-13) define the two conditions that have to be satisfied in equilibrium. An internal solution G has to be at a level so the median voter corresponds to an agent that do not want to alter G . As in the main text, in equilibrium prices are $p(i) = 1$ for all i and hence $\tau = G$. Formally, we then have

$$h(\tau) = m(\tau).$$

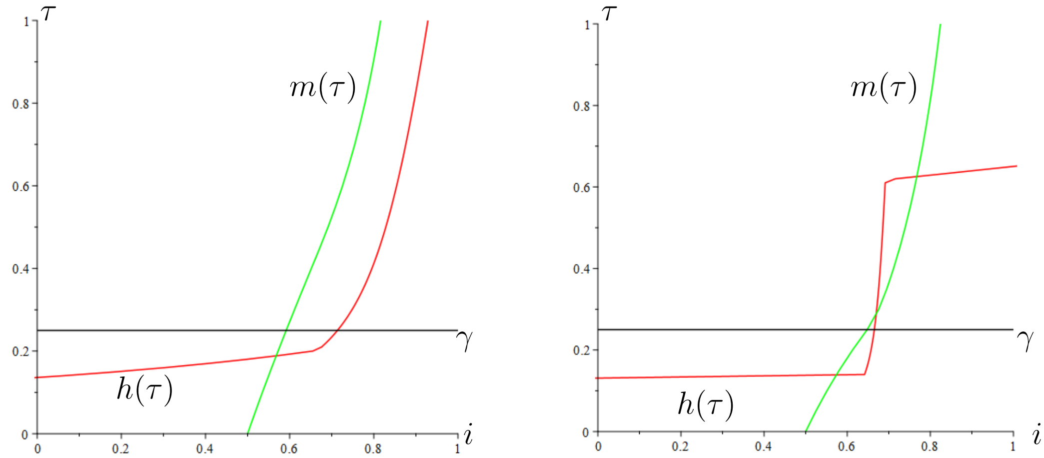
As both $h(\tau)$ and $m(\tau)$ are upward sloping, there will be cumulative forces at play as in the simpler model in the main text. Expectations about a high τ will attract many workers to the high g sectors and the median voter is one who prefers a high τ. Conversely, expectations about a low G will attract many workers to low g sectors and the median voter is one who prefers a low τ. Equilibrium requires that the expected τ is preferred by the median voter. Depending on the exact distribution of g, these cumulative forces may generate multiple equilibria.

We may now conclude. Our impossibility result in the main text, namely that the combination of competitive markets, free entry and democracy is inconsistent with allocative efficiency, also holds when we extend our model with a continuum of sectors. The result arises as a trilemma where it is impossible to jointly satisfy

- Efficiency, i.e. $\tau = \gamma$.
- Democracy, i.e. τ determined by voter preferences $h(\tau)$.
- Free entry, i.e. identity of median voter determined by allocation of workers, $m(\tau)$.

Proposition A-1 *The combination of competitive markets, free entry, and democracy will generally not deliver an efficient outcome.*

Proof. *The political condition $h(\tau) = m(\tau)$ and the condition for efficiency $\tau = \gamma$ yields an overdetermined system. It would only be by coincidence if $h(\gamma) = m(\gamma)$.* ■



(a) Unique equilibrium, subotimal G, $\tau < \gamma$.

(b) Multiple equilibria.

Figure 4: Political economy equilibria with continuum of sectors.

In Figure 4 we have illustrated the impossibility result with two examples. In panel a) there is a unique equilibrium with $\tau = G < \gamma$. In panel b) there are multiple equilibria, similar to the one in our main text, but now with a continuum of sectors.

Appendix: Additional Proofs for online publication

Proof of Lemma 2

If $\tau = \widetilde{\tau}(l_N)$, equation (33) holds with $n_N = l_N$ and $n_T = l_T$. In principle, (33) might also hold for other (n_N, n_T) satisfying $\frac{n_N}{n_T} = \frac{\alpha+\widetilde{\tau}(l_N)\beta}{\beta(1-\widetilde{\tau}(l_N))}$. However, those (n_N, n_T) all require $n_N < l_N$ and $n_T < l_T$, which violates equation (31). Part (i) then follows.

Part (ii) and (iii) build on two observations:

Observation 1: Assume that $n_N = l_N$. Then, (33) implies $n_T = \frac{\beta(1-\tau)}{\alpha+\tau\beta} l_N$. This may in turn hold only if $1 - l_N \geq \frac{\beta(1-\tau)}{\alpha+\tau\beta} l_N \Leftrightarrow l_N \left[1 + \frac{\beta(1-\tau)}{\alpha+\tau\beta}\right] \leq 1 \Leftrightarrow l_N \frac{\alpha+\beta}{\alpha+\tau\beta} \leq 1 \Leftrightarrow \tau \geq \frac{l_N(\alpha+\beta)-\alpha}{\beta} = \widetilde{\tau}(l_N)$. Hence, $n_N = l_N$ only if $\tau \geq \widetilde{\tau}(l_N)$ (necessary condition), while $n_N < l_N$ if $\tau < \widetilde{\tau}(l_N)$ (sufficient condition).

Observation 2: Assume that $n_T = l_T = 1 - l_N$. Then, (33) implies $n_N = \frac{\alpha+\tau_C\beta}{\beta(1-\tau)}(1 - l_N)$. This may in turn hold only if $l_N \geq \frac{\alpha+\tau\beta}{\beta(1-\tau)}(1 - l_N) \Leftrightarrow l_N \geq \frac{\alpha+\tau\beta}{\beta+\alpha} \Leftrightarrow \tau \leq \frac{l_N(\beta+\alpha)-\alpha}{\beta}$. Hence, $n_T = l_T$ only if $\tau \leq \widetilde{\tau}(l_N)$ (necessary

condition), while $n_T < l_T$ if $\tau > \widetilde{\tau}(l_N)$ (sufficient condition).
Observation 1 states that if $\tau < \widetilde{\tau}(l_N)$, $n_N < l_N$. It then follows from full employment that $n_T = l_T$. Inserting $n_T = l_T$ into equation (33) completes the proof of Part (ii). Observation 2 states that if $\tau > \widetilde{\tau}(l_N)$, $n_T < l_T$. It then follows from full employment that $n_N = l_N$. Inserting $n_N = l_N$ into equation (33) completes the proof of Part (iii).

Proof of Lemma 3

The proof follows readily by first noting two observations: (i) Note from the utility functions (35) and (36) that if sectoral employment levels were not dependent on the tax rate, i.e. if n_N and n_T were constants, then for both types of workers the tax rate that maximized utility would be the one that maximizes $(1-\tau)^{1-\gamma}\tau^{\gamma}$, which would imply $\tau_N = \tau_T = \gamma$. (ii) Note from the utility functions (35) and (36) that if $(1-\tau)^{1-\gamma}\tau^{\gamma}$ were a constant, then for a given labor force composition l_N, the tax rate preferred by the non-traded sector workers would be the one that maximizes $(n_N(\tau))^{1-\gamma}(n_N(\tau)+n_T(\tau))^{\gamma}$, i.e. the full employment tax rate, while the tax rate preferred by the traded sector workers would be the one that maximizes $(n_T(\tau))^{1-\gamma}(n_N(\tau)+n_T(\tau))^{\gamma}$, i.e. the full employment tax rate. Finally, note that in the special case we are looking at, the full employment tax rate is given by $\widetilde{\tau} = \gamma$.

The proof is then completed by noting that the terms from observation (i) and from observation (ii) are multiplied in the utility functions (35) and (36), and that the terms from observation (i) and from observation (ii) are both maximized by the same unique tax rate $\tau_N = \tau_T = \widetilde{\tau} = \gamma$. Naturally, when two terms are maximized at the same parameter value, then these two terms multiplied are also maximized at this same parameter value.

Proof of Lemma 4

We consider two main configurations. Configuration "n-short" has equal wages and full employment in N sector. Configuration "t-short" has equal wages and full employment in T sector. "n-short" is only consistent with tuples (l_N, τ) such that $\tau \geq \tilde{\tau}(l_N)$ (to the left of the zero arbitrage line in Figure 1) and "t-short" is only consistent with tuples (l_N, τ) such that $\tau \leq \tilde{\tau}(l_N)$ (to the right of the zero arbitrage line in Figure 1). The overall utility profile for $j = N, T$

is made up of segment $U_j^{\text{t-short}}$ for $\tau < \tilde{\tau}$ and $U_j^{\text{n-short}}$ for $\tau > \tilde{\tau}$:

$$U_j = \begin{cases} U_j^{\text{t-short}} & \text{if } \tau < \tilde{\tau}(l_N) \\ U_j^{\text{n-short}} = U_j^{\text{t-short}} & \text{if } \tau = \tilde{\tau}(l_N) \\ U_j^{\text{n-short}} & \text{if } \tau > \tilde{\tau}(l_N). \end{cases} \tag{A-14}$$

To find the indirect utilities in these regimes we insert (15) into (16) and (17):

$$\begin{aligned} U_N^{\text{t-short}} &= \Omega \frac{1}{\beta} \frac{1-l_N}{l_N} (1-\tau)^{-\gamma} \tau^{\gamma} (\alpha+\beta\tau)^{\alpha+\beta}, \\ U_T^{\text{t-short}} &= \Omega \frac{1}{\beta^{\gamma}} \left(\frac{1-l_N}{l_N} \right)^{\gamma} (1-\tau)^{\alpha+\beta-\gamma} \tau^{\gamma}, \\ U_N^{\text{n-short}} &= \Omega (1-\tau)^{\alpha+\beta} \tau^{\gamma} (\alpha+\beta\tau)^{-\gamma}, \\ U_T^{\text{n-short}} &= \Omega \beta^{\alpha+\beta} \frac{l_N}{1-l_N} (1-\tau)^{2\alpha+2\beta} \tau^{\gamma} (\alpha+\beta\tau)^{-\beta-\alpha-\gamma}, \end{aligned}$$

where $\Omega \equiv \Phi l_N^{\gamma} (\alpha+\beta)^{\gamma}$, (and as before $\Phi \equiv \frac{\alpha^{\alpha}\beta^{\beta}}{(\alpha+\beta)^{\alpha+\beta}}$), and where the superscripts indicate the configuration.
Our goal is first to find the τ that would maximize utility for each group within each configuration. The preferred tax rate is denoted τ_j^i for group $j = N, T$ in configuration i =t-short,n-short.

Starting from the first expression above, we see that $U_N^{\text{t-short}}$ approaches infinity when τ approaches unity, hence

$$\tau_N^{\text{t-short}} = 1,$$

Next, we see that $U_T^{\text{t-short}}$ approaches infinity when τ approaches unity if and only if $\gamma > 1/2$. When $\gamma < 1/2$, $U_T^{\text{t-short}}$ has its maximum when

$$\frac{dU_T^{\text{t-short}}}{d\tau} = U_T^{\text{t-short}} \left[\frac{\gamma}{\tau} - \frac{(\alpha+\beta-\gamma)}{(1-\tau)} \right] = \frac{U_T^{\text{t-short}}}{\tau(1-\tau)} \left[(\alpha+\beta)\tau - \gamma \right] = 0.$$

Hence,

$$\tau_T^{\text{t-short}} = \min\left[\frac{\gamma}{\alpha+\beta}, 1 \right].$$

It is readily seen that both $U_N^{\text{n-short}}$ and $U_T^{\text{n-short}}$ are zero for $\tau = 1$ and $\tau = 0$.When $\tau \in \langle 0, 1 \rangle$, however, utilities are positive, continuous and differentiable functions of τ. Therefore, in the "n-short" configuration, the utilities have maximum in the open interval $\tau \in \langle 0, 1 \rangle$ when the following derivatives are zero[27]:

$$\begin{aligned}
\frac{dU_N^{\text{n-short}}}{d\tau} &= U_N^{\text{n-short}}\left[\frac{\gamma}{\tau}-\frac{\beta\gamma}{(\alpha+\beta\tau)}-\frac{\alpha+\beta}{(1-\tau)}\right], && \text{(A-15)}\\
\tau_N^{\text{n-short}} &= \Big\{\tau\in\langle 0,1\rangle : \frac{U_N^{\text{n-short}}}{\tau\,(\alpha+\beta\tau)\,(1-\tau)}\\
&\quad\times\left[-\beta(\alpha+\beta)\tau^2-(\alpha^2+\alpha\gamma+\alpha\beta)\tau+\alpha\gamma\right]=0\Big\},\\
\frac{dU_T^{\text{n-short}}}{d\tau} &= U_T^{\text{n-short}}\left[\frac{\gamma}{\tau}-\frac{\beta}{(\alpha+\beta\tau)}-2\frac{\alpha+\beta}{(1-\tau)}\right], && \text{(A-16)}\\
\tau_T^{\text{n-short}} &= \Big\{\tau\in\langle 0,1\rangle : \frac{U_T^{\text{n-short}}}{\tau\,(\alpha+\beta\tau)\,(1-\tau)}\\
&\quad\times\left[-\beta(\alpha+\beta)\tau^2-(2\alpha^2+\alpha\gamma+\beta(1+2\alpha-\gamma))\tau+\alpha\gamma\right]=0\Big\}.
\end{aligned}$$

We have now characterized potential preferred tax rates in both configurations. First, we compare these tax rates with the social optimum $\tau=\gamma$. From inserting $\tau=\gamma$ in (A-15), it follows that $\tau_N^{\text{n-short}}<\gamma$. From inserting $\tau=\gamma$ in (A-16), it follows that $\tau_T^{\text{n-short}}<\gamma$. Moreover, $\tau_N^{\text{n-short}}$ and $\tau_T^{\text{n-short}}$ can be ordered as follows: $\tau_T^{\text{n-short}}<\tau_N^{\text{n-short}}<\gamma$. This result follows from comparing (A-15) to (A-16), where we see that $\frac{dU_T^{\text{n-short}}}{d\tau}=-U_T^{\text{n-short}}\frac{\alpha+\beta}{(1-\tau)}<0$ when $\frac{dU_N^{\text{n-short}}}{d\tau}=0$. Hence, the ordering is

$$\tau_T^{\text{n-short}}<\tau_N^{\text{n-short}}<\gamma<\tau_T^{\text{t-short}}\le\tau_N^{\text{t-short}}=1. \qquad \text{(A-17)}$$

These preferred tax rates are derived conditional on the economy being in each of two configurations. In order to get a valid characterization, we need to determine when these tax rates are consistent with their respective configuration definitions (t-short when $\tau\le\tilde{\tau}(l_N)$ and n-short when $\tau\ge\tilde{\tau}(l_N)$).

Given the ranking (A-17), for a given l_N, there is at most one valid candidate tax rate from the list (A-17) for each $j=N,T$. For a t-short candidate to be valid, it has to be larger than $\tilde{\tau}$. For an n-short candidate to be valid, it has to be smaller than $\tilde{\tau}$. If there is a valid candidate, it will be the preferred tax. If there is no valid candidate, then the preferred τ is at the border where $\tau=\tilde{\tau}(l_N)$ and where $U_j^{\text{n-short}}=U_j^{\text{t-short}}$. Hence, for a given l_N, and a given

[27] The second order conditions are trivially satisfied as the derivatives have at most two roots and as the utilities have a bell shaped profile between $\tau=0$ and $\tau=1$.

$\tilde{\tau}(l_N)$, group j will prefer

$$\begin{array}{ll} \tau_j^{\text{n-short}} & \text{if } \tilde{\tau}(l_N) < \tau_j^{\text{n-short}} < \tau_j^{\text{t-short}}, \\ \tilde{\tau}(l_N) & \text{if } \tau_j^{\text{n-short}} < \tilde{\tau}(l_N) < \tau_j^{\text{t-short}}, \\ \tau_T^{\text{t-short}} & \text{if } \tau_j^{\text{n-short}} < \tau_j^{\text{t-short}} < \tilde{\tau}(l_N). \end{array}$$

These conditions on $\tilde{\tau}$ can be translated into conditions on l_N: N-workers will prefer $\tau_N^{\text{n-short}}$ when $l_N < \underline{l}_N$. They will prefer $\tau = \tilde{\tau}$ when $l_N \geq \underline{\lambda}_N$, where $\underline{\lambda}_N = \dfrac{\beta\tau_N^{\text{n-short}} + \alpha}{\beta + \alpha}$. We therefore obtain

$$\tau_N(l_N) = \begin{cases} \underline{\tau}_N \equiv \tau_N^{\text{n-short}} & \text{if } l_N < \underline{\lambda}_N \\ \tilde{\tau}(l_N) = \frac{l_N(\beta+\alpha)-\alpha}{\beta} & \text{if } \underline{\lambda}_N \leq l_N \leq 1 \end{cases},$$

which is the first part of the lemma (when we also make the notation more compact by writing $\underline{\tau}_T$, $\underline{\tau}_N$ etc).

Similarly, T-workers will prefer $\tau_T^{\text{n-short}}$, when $l_N < \underline{l}_N^*$. They will prefer $\tau = \tilde{\tau}$ when $\underline{\lambda}_T < l_N < \bar{\lambda}_T$ and $\tau_T^{\text{t-short}}$ when $l_N \geq \bar{\lambda}_T$, where $\underline{\lambda}_T = \dfrac{\beta\tau_T^{\text{n-short}} + \alpha}{\beta + \alpha}$ and $\bar{\lambda}_T = \dfrac{\beta\tau_T^{\text{t-short}} + \alpha}{\beta + \alpha}$:

$$\tau_T(l_N) = \begin{cases} \underline{\tau}_T \equiv \tau_T^{\text{n-short}} & \text{if } l_N < \underline{\lambda}_T \\ \tilde{\tau}(l_N) = \frac{l_N(\beta+\alpha)-\alpha}{\beta} & \text{if } \underline{\lambda}_T \leq l_N \leq \bar{\lambda}_T \\ \bar{\tau}_T \equiv \tau_T^{\text{t-short}} & \text{if } \bar{\lambda}_T < l_N \end{cases},$$

which is the second part of the lemma, and thus completes the proof.

Proof of Proposition 8

Using (38), (39) and (40), as well as $w_T = 1$ and $w_N = p$, in (1) it follows that traded sector workers now obtain the utility

$$U_T = \Phi(1-\tau)^{1-\gamma}(\tau)^{\gamma}\left(l_N + \frac{(1-l_N+R)}{p}\right)^{\gamma}(p)^{-\alpha}(1+R)^{\alpha+\beta}, \qquad \text{(A-18)}$$

where again $\Phi \equiv \frac{\alpha^\alpha \beta^\beta}{(\alpha+\beta)^{\alpha+\beta}} > 0$.

The traded goods sector supply is now given by $l_T + R$, and supply equals demand when

$$l_T + R = \frac{\beta}{\alpha+\beta}(1-\tau)\left[pl_N + l_T + R\right].$$

The market clearing condition thus reads

$$p = \frac{l_T + R}{l_N} \frac{\alpha + \tau\beta}{\beta\,(1-\tau)}. \tag{A-19}$$

Inserting this in (A-18) we obtain

$$U_T = \Lambda_T \frac{(l_T)^{\alpha}}{(l_T + R)^{\alpha}} (1+R)^{\alpha+\beta} (1-\tau)^{2\alpha+\beta} (\tau)^{\gamma} (\alpha + \beta\tau)^{-\alpha-\gamma}, \tag{A-20}$$

where again, as in equation (19), $\Lambda_T = \Phi \frac{(l_N)^{\alpha+\gamma}}{(l_T)^{\alpha}} (\alpha+\beta)^{\gamma} \beta^{\alpha}$. Comparing this expression with (19), we note that the three last terms containing the tax rate τ are identical to the three last terms in (19). This has a simple implication: the tax rate preferred by traded sector workers is independent on the amount of resource rents R.

Using (A-19) with the free entry arbitrage condition that $p = 1$, we note that the threshold tax rate from Proposition 2, $\frac{\beta-\alpha}{2\beta}$, is now replaced by

$$\frac{\beta - \alpha(1+2R)}{2\beta(1+R)} < \frac{\beta-\alpha}{2\beta}. \tag{A-21}$$

Since the preferred tax rate of the traded sector workers is independent of R, the parameter space where the traded sectors workers are the decisive voters, $\tau = \tau_T$, has thus decreased. Moreover, for a sufficiently high R, the threshold tax rate will always exceed $\frac{\beta-\alpha(1+2R)}{2\beta(1+R)}$, which completes the proof.